CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

“Cooperativa Lar Wastewater Treatment and Energy Generation Project”
Version: 08
Date of Completion: 02/08/2010

A.2. Description of the small-scale project activity:

Cooperativa Agroindustrial Lar is an agricultural cooperative which acts in the area of agro-business. It was founded on 1964 by a group of farmers who had decided to join in a better organization and thus, take advantage of their synergies and get higher competitiveness in the acquisition of agricultural inputs, as well in the commercialization process of their production.

Cooperativa Agroindustrial Lar owns the following commercial and industrial complexes:

- Industrial unit of Cassava;
- Industrial unit of Chicken;
- Industrial unit of Rations;
- Industrial unit of Soy;
- Industrial unit of Vegetables;
- Unit of Packing Victuals;
- Unit of Soy-seed Processing;
- Unit of Egg Processing;
- Unit of Swine Breeding;
- Unit of Storage;
- Laboratory of Analysis of Seeds;
- Supermarket with 13 Stores;
- Industrial Unit of fertilizers;

The project activity is going to be developed at the waste water treatment plant for the effluent from the slaughterhouse of the industrial unit of chicken.

The proposed project activity will modify the current wastewater treatment management system and will be implemented in two stages. The first stage (with a wastewater flow of 150 m^3/h) consists of partially recovering the biogas generated during the anaerobic treatment with the aim of generating electricity from biogas. In this stage there will not be an increase in the water inflow.

In the second stage, wastewater inlet flow will be increased progressively up to approx. 350m^3/h. The aim of the project activity in this second stage of implementation is to avoid methane emissions by replacing anaerobic by aerated treatments and on the other hand to recover biogas for electricity generation. Out of the whole water inflow, 80 m^3/h will enter the bio-digesters and will be re-circulated after digestion to the homogenization tank, where it will be mixed with the inlet water flow.

During the validation of this project activity, the first stage was being implemented. The Project Proponents have considered that the description of the whole implementation process was relevant and helpful for any reader to deeply understand the project activity and the reasons of driving the process of implementation in two stages.

The project promoter expects that the second stage of implementation will start its operation on October 2010.. However, the expected date of registration is November, 1^{st}, 2010. Hence, the calculations of emissions reductions are referred to this date (November, 1^{st}, 2010) onwards. Despite the above, the project participants have explained the whole implementation process in this PDD, so it will be clear and understandable to any reader.

The stages can be distinguished one from the other because in the first stage the water flow keeps being the same as before the implementation of the project activity. When the production capacity in Cooperativa Lar starts to increase, the second stage is supposed to start.

As mentioned above, Cooperativa Lar is planning to increase its chicken production capacity in the next years. The increase of the production capacity will entail an increase in the wastewater flowing to the wastewater treatment. With today's treatment capacity, the whole water flow could not be properly treated. However, Cooperativa Lar would clearly decide to open new anaerobic lagoons to reach a minimum retention time and would keep on operating as currently, with larger treatment capacity. Hence, emissions due to the anaerobic degradation of wastewater would keep happening, no biogas would be recovered for electricity generation and no modification to aerated treatment would occur in the absence of the proposed project activity.

The project also is aimed on the reuse of the 100% of the water used in the production process: 70% of treated water will be reused in the chicken industrial process. The water treatment plant designed for water reuse, which is out of the project boundary, will have a treatment capacity of 300 m^3/h and will redirect final sludge to the homogenization tank. The treatment will consist of a chemical flocculation process, a sedimentation process and a filtration process. Micro-organisms will be eliminated through a UV disinfection process. The remaining 30% will be stored in the final irrigation lagoons and will be used for irrigation of eucalyptus at Cooperativa Lar's land.

Solid wastes separated by flotation in the PC flotation tank will be dried and treated to be used as animal feedstock. At the end of the wastewater treatment, resulting sludge will be redirected to the homogenization tank to maintain the required level of bacteria in the wastewater treatment. Hence, the process is designed in such a way that no wastes will be generated.

Currently, organic matter resulting from the wastewater treatment is conducted lagoon by lagoon until facultative and polishing lagoons and there, water is used for fertilizing-irrigation of eucalyptus.

The project activity will therefore reduce GHG emissions from three sources: avoidance of methane emissions from the existing open anaerobic lagoons by the installation of biogas recovery systems, avoidance of methane emissions through the replacement of anaerobic systems by aerated treatments and the displacement of electricity from the grid with less carbon intensive electricity source (biogas).

- **Avoidance of methane emission from anaerobic decomposition of wastewater from the open lagoons treatment system**: by the modification of two out of the three existing anaerobic open lagoons into two biodigesters, methane generated in the anaerobic treatment will not be released to the atmosphere, but recovered. The proposed project activity will mitigate GHG emissions from anaerobic decomposition of wastewater in an economically sustainable manner, and will result in other direct environmental benefits, such as improved water quality, reduced risks of explosion and reduced odour. In other words, the project proposes to move from a high-GHG wastewater treatment practice, consisting of open air anaerobic lagoons, to a lower-GHG practice, with anaerobic digestion, biogas capture and combustion. For this purpose, the methodology to be applied will be AMS III-H.

- **Avoidance of methane emissions through the replacement of anaerobic systems without methane recovery by aerated systems for wastewater treatment**: in a second phase, this project proposes to modify the anaerobic lagoons to aerated treatment for the foreseen increase of treatment capacity. By the modification of the baseline anaerobic treatment in open lagoons and the installation of aerating equipment, methane emissions due to the anaerobic wastewater treatment will be partially avoided, thus contributing to a lower GHG wastewater treatment. The methodology applicable to this modification is AMS III-I.

- **Displacing carbon intensive grid electricity by onsite generation of renewable energy (using two biogas gensets):** GHG emissions will be also partially mitigated by reducing carbon intensive grid electricity consumption due to electricity generation from recovered biogas during anaerobic digestion process. The recovered biogas will be combusted in specific engines and electricity will be generated and consumed for internal purposes (both project equipment and not project related equipment) or could be exported to the grid. The methodology applicable is AMS I-D.

- **Combustion of excess methane in a flare**: in case excess recovered biogas or impossibility of electricity generation in the installed engines, biogas recovered from anaerobic digestion will be flared on a safety torch which will be type open flare. The project proponent has decided to relinquish the emissions reduction due to the biogas flaring in this open flare. However, the project proponent will install the safety torch for excess biogas flaring and will also combust biogas in the engines for power generation. In a conservative approach and for calculation and monitoring purposes, only biogas combusted in the engines will be considered to be destroyed. Only this biogas combusted in the engines will be accounted in the ER calculation, as if excess biogas was not destroyed in the flare at all (considering a flare efficiency of zero). Since emission reductions from excess biogas flared are not being accounted in a conservative approach, this equipment is out of the project boundary.

- **Reuse of the wastewater treated in the plant**. A large amount of water is used for the production process in Cooperativa Lar. This water is mainly taken from river Xaxim. With the implementation of the project, Lar Agroindustries will reuse all the treated water and, thus, will reduce the water required from the river. With the implementation of the proposed project, a treatment plant will be installed to finally treat the effluent and allow reusing it in the industrial process. This way, around 70% of the water treated in the plant will be reused for the industrial process and the rest will be used for fert-irrigation.

Contribution to sustainable development
The project activity contributes to regional and national sustainable development in the following ways:

<u>Environmental benefits:</u>

- **Mitigation of uncontrolled GHG emission from the lagoons**: by recovering the methane that is currently being emitted from the open anaerobic lagoons and by generating electricity from the recovered methane, the project directly contributes to reduce GHG emissions. By recovering the currently uncontrolled methane emissions, the project activity will also reduce the emissions of generated sulphides. Moreover, by modifying the current anaerobic treatment onto an aerated treatment well managed, methane emissions from the anaerobic treatment will be avoided.
- **Mitigation of unpleasant odours and improvement of air quality:** by installing the covering systems and the methane recovery equipment at the existing open anaerobic lagoons, odours currently emanating will almost disappear and air quality will be improved.
- **Mitigation of potential safety hazards from the uncontrolled emission of methane, which is highly combustible**: by recovering the generated methane from the anaerobic degradation of wastewater, this methane will be flared in a safety torch or will be used in engines for electricity generation, thus the risk of explosion will be minimum taking into account that biogas will be recovered and monitored in a controlled manner;
- **Reduction of water demand for irrigation:** according to the Ministry of Environment of Brazil, the State of Paraná consumes around 27% of total water demand in Brazil. Out of this total demand, 33% is used for irrigation[1]. With the implementation of the project activity, wastewater from the slaughterhouse will be treated and partially reused for irrigation purposes (30% of outlet water), thus reducing the water demand in the region.
- **Reduction of water demand for industrial purposes:** water treated will be partially reused for industrial purposes (70% of treated water). The industrial process developed in Lar consumes huge quantities of water. With the implementation of the proposed project, the water demand for the industrial process will be significantly reduced because of water reuse, which otherwise will not be possible.

[1] **Ministerio do Meio Ambiente.** Regiao Hidrográfica do Paraná. *http://pnrh.cnrh-srh.gov.br/*

Social benefits:

- **Improvement of air quality and local environment**: the installation of the covering systems for the anaerobic open lagoons, the methane recovery systems and the modification of anaerobic to aerated treatment will reduce and avoid methane uncontrolled emissions, thus eliminating the odours currently emanating from the open lagoons. Hence, local community life quality will materially improve.
- **Employment creation**: the local employment for skilled labour for the manufacturing, installation, operation and maintenance of the specific equipment, will contribute to increase the local employment rates. In addition, the project will lead operators and management team in Lar to acquire a new technical knowledge and new operation habits, more respectful with environment. In fact, the newly designed water treatment will require a different and more complex operation and maintenance procedures than the current anaerobic treatment in open lagoons. The current treatment only requires to monitor the water flow and the organic matter loads in the water outflow. Every five years, approximate, the anaerobic open lagoons are emptied and sludge is used in bales for fertilization of eucalyptus. The operation and maintenance procedures are widely covered with one person. However, with the implementation of the project activity, there will be required more people to develop the O&M procedures, much more complex when biodigesters and aeration equipment is involved in the treatment process.

Economicall benefits:

- **Efficiency of Utilization of Resources:** the project results in a more efficient utilization of water resources and products by turning a residual product from the wastewater treatment into an energy source which will also displace electricity demand from the grid.
- **Local life quality improvement:** the project will develop a crucial role in the improvement of the local life quality by creating direct and indirect employment, by bringing clear benefits to the concerned sectors, by bringing a new technical knowledge and operation methods and by demonstrating the feasibility and the advantages of recovering methane from wastewater treatment and reusing treated water, becoming an example for other sectors and companies.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity (ies) project participants (as applicable	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/ No)
Brazil	Cooperativa Agroindustrial Lar	No
	Zeroemissions do Brasil Ltda.	No
The Netherlands	Zero Emissions Technologies SA	No
In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Federative Republic of Brazil

A.4.1.2. Region/State/Province etc.:

State of Paraná

A.4.1.3. City/Town/Community etc:

Municipality of Matelândia

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The Cooperativa Lar industrial unit of chicken, where the project activity is going to be developed, is located at Rod. BR277, km 653, Agrocafeeira, Matelandia, in the State of Paraná, South Brazil. (Fig. 1)

Fig. 1. Location of Cooperativa Lar in the State of Paraná, South Brazil.

Fig. 2. Lar's Slaughterhouse. Project activity site.

The specific location of the project site was taken during the site visit.
Between lagoons 1 and 2 (new biodigesters) the GPS coordinates are:

- S 25º 12.1577'
- W 53º 57.1925

Accuracy of 25 m.

At the currently existing flotation tank, GPS coordinates are:

- S 25º 12.2618'
- W 53º 57.1302'

Accuracy of 5.5m

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

As per Appendix B of the simplified modalities and procedures for small-scale project activities, the project activity falls under three project types:

Project activity: Cooperativa Lar Wastewater Treatment and Energy Generation Project

Type: III. Other Project Activities
Category: III.H. Methane recovery in wastewater treatment
Version: 13

Type: III. Other Project Activities
Category: III.I. Avoidance of methane production in wastewater treatment through the replacement of anaerobic systems by aerated systems.
Version: 8

Type: I. Renewable Energy Projects
Category: I.D. Grid connected renewable electricity generation
Version: 15

Wastewater from the slaughterhouse is currently being treated at the wastewater treatment plant, which consists of the following treatment steps:

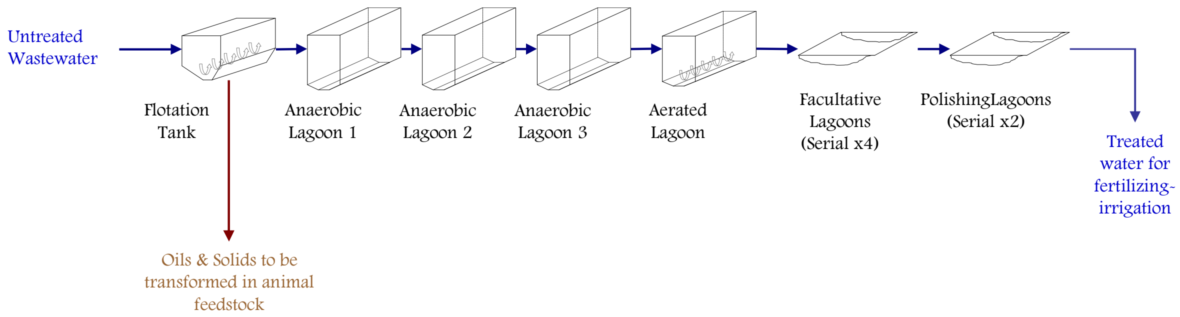

Fig. 3. Current Wastewater Treatment at Lar Slaughterhouse

Wastewater from the industrial unit of chicken enters the flotation tank, where large size and low density matter (feathers, chincken parts and other sizeable solids) is removed from wastewater through physical separation (flotation). Low density matter is flotated to the upper part of the water sheet and separated. This matter, mainly composed of chicken parts not used in the production process, are used as animal feedstock. The water stream is then conducted to three serial anaerobic lagoons, where wastewater is anaerobically decomposed. The depth of the lagoons (over 5m) ensures anaerobic conditions. Moreover, a thick grease cover is formed on water surface, thus contributing to avoid air contact with wastewater. During this anaerobic degradation, organic matter in wastewater is transformed in methane and other substances.

Water flows through the anaerobic lagoons and several chemical reactions take place (see annex 3), thus generating methane, CO_2 and H_2S. With the increasing degradation of organic matter in wastewater, methane generation potential decreases.

After anaerobic treatment, water streams flow to an existing aerated lagoon which is poorly managed in the baseline situation. The aeration of this lagoon is not efficient enough to remove all the organic matter. Hence, wastewater exiting from this aerated lagoon still carries a high amount of organic matter and, when it flows to the facultative lagoons, a grease cover is formed, thus showing that the organic matter removal process is not efficient. After flowing through four serial facultative lagoons, wastewater goes to the polishing lagoons where pumps are installed to make it possible to use this treated water with all the organic matter for fertilizing-irrigation. This treated water is used in the baseline for fertilizing-irrigation of the eucalyptus forest near the slaughterhouse, The sludge present in the treated water is a nutrient matter for land. This is the reason why there is no need of sludge treatment in the baseline situation.

An increase of the plant production capacity is foreseen and it will increase also the wastewater inflow. In the absence of the project activity, Cooperativa Lar, owning the adjacent land, would open new similar lagoons (anaerobic, facultative and polishing) to receive the increased wastewater inflow and treat it wastewater the same way than in the baseline. Hence, if the proposed project activity was not developed, new lagoons will be opened in the zone in order to ensure a sufficient organic matter removal from wastewater. The main requirement to be accomplished in such a treatment system is the minimum retention time. Considering this requirement, the volume to be excavated is calculated (fixing the minimum retention time) for anaerobic, facultative and polishing lagoons.

The combination of lagoons is not fixed; it is only required that the anaerobic conditions will be guaranteed and that the retention time will be over a minimum value. Starting from these considerations and with the volume to be excavated already calculated, the combination of lagoons can be chosen.

The required minimum volume for treating the increase wastewater flow is calculated based on the current retention time in the anaerobic lagoons. A minimum volume of 75,483 m^3 would be necessary for anaerobic lagoons. Considering the volume of the existing lagoons (from 25,122 to 14,840 m^3) and the volume to excavate, calculated and resulted in 204,312.87m^3, a quotation made by an engineering company for this works, considered that three new anaerobic lagoons would be excavated.

In this situation, uncontrolled methane emissions will be released to the atmosphere. The proposed project activity is focused on the improvement of treatment efficiency and, by avoiding methane emissions to the atmosphere and by generating electricity from a renewable source (biogas recovered), will contribute to mitigate Climate Change.

The wastewater flow characteristics in each stage of implementation of the proposed project activity and the expected schedule of operation starting of each stage are shown in the following table:

Stage of Implementation	Processed Chickens per Day	Q inlet (m3/h)	Starting Date of Stage
Current	**120,000**	**150**	Current
Stage 1	**143,000**	**179**	June-Sept 2010
Stage 2-I	**178,000**	**223**	Oct-Dec 2010
Stage 2-II	**205,000**	**256**	Jan-Mar 2011
Stage 2-III	**263,000**	**329**	April-June 2011
Stage 2-IV	**280,000**	**350**	July-Dec 2011

Table 1. Operational data. Source: Project Owner

Since the water flow increases proportionally to the increase in the production activity at Lar's industrial facility, it has been considered that organic load in wastewater keeps in the same range before and after flow increase.

The current water treatment is treating a water flow of 150m^3/h. From August 2009, it was expected that stage 1 of implementation starts, but it has been delayed and, this stage was starting the implementation and being commissioned during the validation process of this PDD. This means that biodigesters would be operating and that biogas engines will start consuming biogas for power generation. The third anaerobic lagoon will be equipped with aeration system and will start operating as aerated and the first existing (poorly managed) aerated lagoon will be re-equipped to increase the aeration efficiency and improve the lagoon management.

This configuration will be operating while the PCF Tank is being built, the pipeline is being adapted and all the required operations are developed in order to implement the second stage of the project. It is expected that this stage will start operating on October 2010. When stage 2 of implementation starts its operation, the wastewater flow will increase progressively up to peak flow (350m^3/h) until July 2011.

The detailed schedule estimated for the installation of equipment and other operations required for the implementation of both stages of the project activity is shown in the following table.

	Starting Date	Finishing Date
1. Anaerobic lagoon 1 cleaning process	20/06/2008	01/11/2008
2. Construction of biodigester 1	11/02/2009	20/07/2009
3. Anaerobic lagoon 2 cleaning process	30/03/2009	30/04/2009
4. Construction of biodigester 2	01/04/2009	30/07/2009
5. Construction of Generation Engines House	15/06/2009	20/07/2009
6. Installation of the pipeline for biogas	15/07/2009	30/07/2009
7. Installation of power generator (1x50kVA)	15/08/2009	16/08/2009
8. Installation of power generator (1x50kVA)	25/08/2009	26/08/2009
9. Deadline of bidding process for flare installation	10/08/2009	10/09/2009
10. Starting date of flare operation	10/09/2009	30/09/2009
11. Installation of aeration equipment in lagoon 3 (former anaerobic)	20/08/2009	15/10/2009
12. Installation of aeration equipment in lagoon 4 (former aerated)	20/08/2009	15/10/2009
13. P-C flotation tank construction	01/11/2009	30/05/2010
14. Installation of power generator (1x100kVA)	15/01/2010	16/01/2010
15. Construction of the homogenization tank	30/05/2010	30/09/2010
16. Installation of aeration equipment in lagoon 5, former facultative nº1	01/10/2010	05/12/2010
17. Construction of the secondary decanter	15/01/2011	15/06/2011
18. Construction of sludge recirculation pipeline	16/06/2011	15/09/2011
19. Installation of filters and disinfection systems	15/10/2011	30/12/2011

The purpose of the proposed project activity is to reduce the uncontrolled methane emissions from wastewater treatment. This target will be achieved in two stages:

1. First stage: current production capacity. This first stage will be implemented in the second half of 2009.

   Wastewater inlet flow will keep as in the baseline situation. In this stage the first two existing anaerobic lagoons will be transformed into two bio-digesters operating in parallel and receiving the inlet flow of 150 m^3/h proportionally to the digesters' volumes:

	Volume (m^3)	**Water Flow Treated**
Biodigester 1	21.822	60%
Biodigester 2	13.134	40%

Table 2. Volume and % of flow treated in biodigesters.

For this transformation, geomembranes will be used for impermeabilization, as follows:

	Cover	Bottom
Biodigester 1	HDPE[2] 0.80 mm	HDPE 1.25 mm
Biodigester 2	PVC 1.00 mm	-

Table 3. Membranes' characteristics

Agitation systems will be installed in order to avoid sedimentation and to increase digestion efficiency and biogas generation capacity. In order to guarantee the correct digestion process, inflow water will be adjusted according to the capacity of each digester, ensuring a minimum retention time of 10 days. The efficiency of the biodigesters will be over 70% as per the Environmental Control Plan (Plan de Controle Ambiental, *PAC*)

Biogas generated will be recovered and combusted for electricity generation in specific engines. In order to accomplish with safety requirements and emergency situations, an open flare will be installed to flare excess biogas in case of low operation of engines or emergency.

The project is designed to maximize the power generation from biogas. For this purpose, three biogas engines will be installed, two in the first stage of implementation of the project and one more in the second stage:

Biogas Engines	**Installed Capacity**
Stage 1	2 x 50 kVA
Stage 2	1 x 100 kVA (and the previously installed 2x50kVA)

Table 4. Characteristics of biogas engines

Power generation from biogas recovered will be 160kW. However, in case that biogas generation efficiency increased, Cooperativa Lar could consider the possibility of installing new engines. In that case, Cooperativa Lar would apply for the modification of the PDD in accordance with Annexes 66 & 67 from EB48.

In this first stage of implementation, the third existing anaerobic lagoon will be modified and equipped with aeration equipment, thus operating as an aerated lagoon. Since there are some aeration equipments installed in the existing aerated lagoon, some of them will be reused in the aeration at this first stage of implementation. However, new aeration equipment will be acquired to ensure a proper aeration in both lagoons. The new equipment to be installed and the existing equipment to be reused, is listed below:

[2] HDPE: High Density PolyEthylene

Stage 1		
	Former Anaerobic Lagoon nº 3 (aerated lagoon 1)	
		2 lines with 8 diffusion units for high efficiency aeration
		2 x 7.5CV installed
		1 x 20 HP reused aeration turbine
	Total aeration equipment power (installed)	
		35 HP
	Former Aerated Lagoon nº 1 (aerated lagoon 2)	
	Conventional aeration equipment (surface aeration turbines)	
		4 x 15 HP reused aeration turbines
		2 x 20 HP reused aeration turbines
	Total aeration equipment power (installed)	
		100 HP

Table 5. Characteristics of aeration equipment newly installed and existing in stage 1 of implementation.

The existing facultative lagoons and the two existing polishing lagoons will keep on operating as up to date.

<u>**Stage 1:** Installation of anaerobic digesters with methane recovery systems.</u>

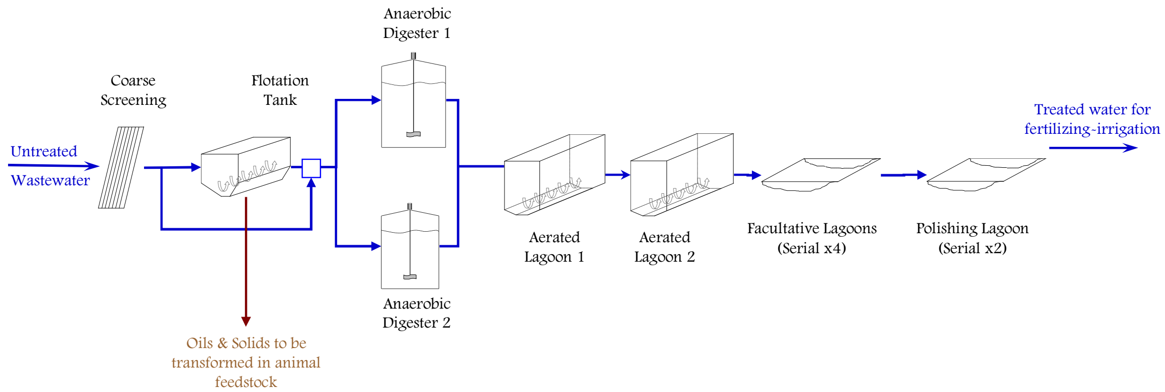

Fig. 4. First stage of implementation of the project activity. Water inflow is anaerobically treated in both digesters. Methane generated from anaerobic degradation of water in digesters is recovered. After digestion, water flows to the new aerated lagoon and is finally discharged in the first existing facultative lagoon.

2. Second stage: after the production expansion in the Industrial Chicken Unit at Lar.

   This second stage is planned to be implemented from October 2010. In this stage, wastewater inflow will progressively increase from the current 150m^3/h up to 350m^3/h as explained before in Table 1. The whole flow will pass through the homogenization tank, from where it will be distributed. Out of the total flow, 80m^3/h will be treated in the biodigesters, thus increasing the retention time with respect to stage 1 of implementation. These 80m^3/h will go back to the homogenization tank after digestion.

   The homogenization tank will also receive 10m^3/h of sludge from the end of the treatment, which will help to maintain the required level of bacteria in wastewater. From the homogenization tank, then, 360m^3/h will be directed to the physical-chemical flotation tank (PCF tank).

   The removal efficiency of the PCF tank is shown in Table 26.

Parameter	Removal efficiency
COD - Chemical Oxygen Demand	≥ 90%
BOD5 - Biological Oxygen Demand 5 Days	≥ 90%
O&G – Oils and Grease	≥ 94%
SS – Suspended Solid	≥ 90%
N – Nitrogen	≥ 65%
P - Phosphorous	≥ 65%

Table 6. Removal efficiency of the new designed Physical-Chemical Flotation Tank according to the Environmental Control Plan

   After this PCF tank, wastewater will pass through three aerated lagoons operating in parallel. These three lagoons are those two refurbished and modified lagoons in stage 1, plus the first facultative lagoon from the baseline, which will be equipped with aeration equipment.

For this aeration, the equipment will be distributed as follows:

Stage 2		
	Former Anaerobic Lagoon nº 3 (aerated lagoon 1)	
		2 lines with 8 diffusion units for high efficiency aeration
		2 x 7.5CV installed
		1 x 20 HP reused aeration turbine
	Total aeration equipment power (installed)	
		35 HP
	Former Aerated Lagoon nº 1 (aerated lagoon 2)	
	Conventional aeration equipment (surface aeration turbines)	
		4 x 15 HP existing aeration turbines
		1 x 20 HP existing aeration turbines
	Total aeration equipment power (installed)	
		80 HP
	Former Facultative Lagoon nº 1 (aerated lagoon 3)	
		2 lines with 8 diffusion units for high efficiency aeration
		2 x 7.5CV installed
		1 x 20 existing aeration tubine (removed from aerated lagoon 2)
	Total aeration equipment power (installed)	
		35 HP

Table 7. Aeration equipment to be installed and distributed during stage 2 of implementation.

The minimum removal efficiency of the aerated lagoons step is shown below:

Parameter	Removal efficiency
COD - Chemical Oxygen Demand	≥ 90%
BOD5 - Biological Oxygen Demand 5 Days	≥ 92%
O&G – Oils and Grease	≥ 90%

Table 8. Minimum removal efficiency of aerated lagoons step, as designed in the Environmental Control Plan.

Treated water will be finally discharged in the new decanter (second existing facultative lagoon). This decanter is the discharge pathway as per AMS.III.I.

Summarizing, the anaerobic treatment in the baseline is displaced in this second stage of implementation, by an aeration treatment consisting on a physical-chemical flotation tank and three lagoons operating in parallel.

Sludge resulting from sedimentation process will be re-directed to the homogenization tank. This way, the level of bacteria required to maintain the aerated biological treatment operating naturally will be optimum.

Treated water exiting the decanter will be directed to an accumulation lagoon.

After this lagoon, a tertiary treatment will be implemented out of the project boundary, to facilitate the reuse of treated water. This tertiary treatment will consist of sand and activated carbon filters which will remove the remaining solid and the phosphorous matters in clarified water. Out of the filtered stream, 30% will be utilized for irrigation and the remaining 70% will be treated for reuse in a new treatment plant for tertiary treatment. The water reuse system will consist of the following:

1. pH stabilization and flocculation chamber;
2. flocculation and sedimentation;
3. filtration:
4. disinfection with UV and HClO.

Stage 2: Increase in the production capacity from 2010.

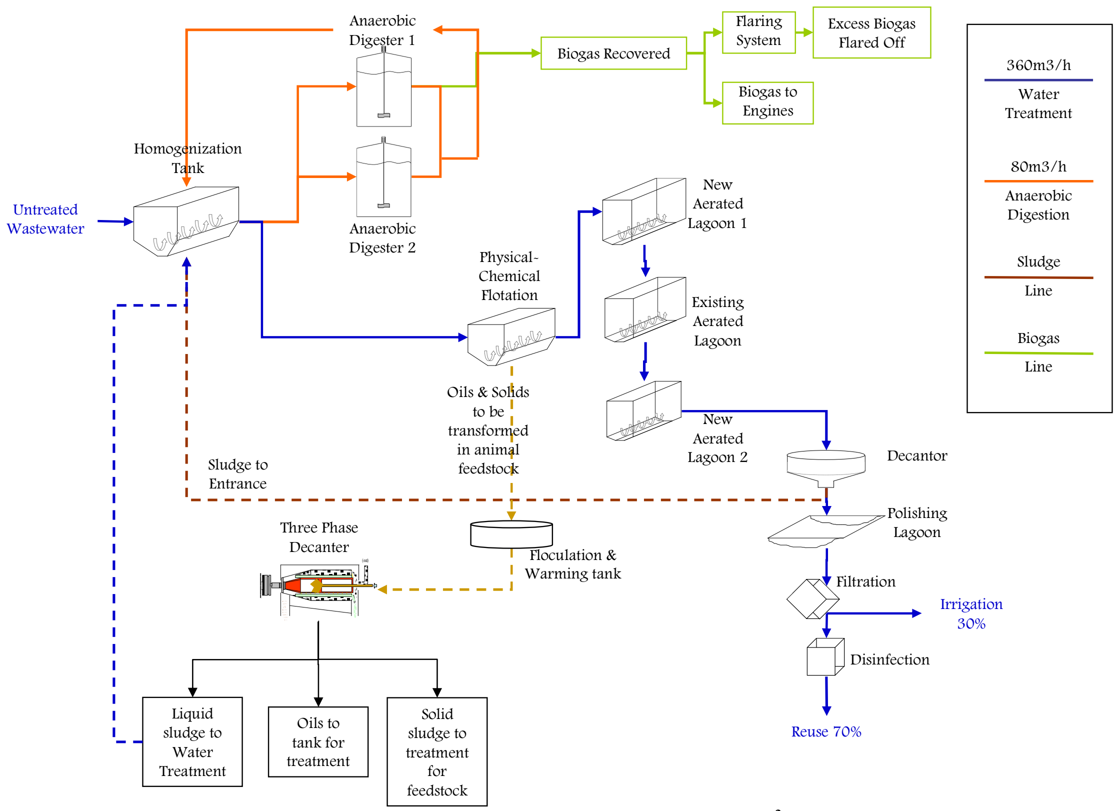

Fig. 5. When production capacity increases, out of the inlet water flow, 80m^3/h from the inflow wastewater are conducted to anaerobic digestion. After digestion, this water inflow meets the remaining water flow at the homogenization tank, before entering the physical-chemical flotation tank. After this treatment step, wastewater is conducted to the new & newly equipped aerated serial lagoons, where water flow is treated through organic matter oxidation, thus avoiding the methane generation and the uncontrolled release to the atmosphere. After this new implemented treatment, water is finally discharged at the former facultative lagoon nº2 which is modified onto a secondary decanter. Biogas recovered in the biodigesters is combusted in biogas engines to generate electricity to be consumed by the project equipment or to be exported to the grid. The solid wastes separated by flotation in the PC flotation tank will be dried and treated to be used as animal feedstock. Oils are treated to be reused in other industries. Liquid sludge is redirected to water treatment to maintain the required bacteria level in the homogenization tank to ensure a proper aerated treatment.

In both stages, the biogas recovered is flared and/or used as a source of energy for electricity generation. Two engines of 50 kVA and one engine of 100 kVA nominal capacity will be installed in the Industrial Chicken Unit of Lar with a total generation capacity of 160 kW. This electricity generation will contribute to displace electricity demand from the grid and will contribute to mitigation of Climate Change. The installed capacity of these engines has been calculated according to the expected biogas generation and methane content. However, in case that biogas generation efficiency increased, Cooperativa Lar could consider the installation of new biogas based generation engines. In case of doing this expansion, the project participants will apply for the modification of the PDD according to Annex 66 and Annex 67 from EB48.

For biogas flaring, an open flare device will be installed where excess biogas will be burnt before being released to the atmosphere. Whenever the power facility is not operational, if biogas production exceeded the combustion capacity of the energy generation system or during equipment maintenance time, the flaring system will be used. Cooperativa Lar will not apply for the carbon credits resulting from the biogas flaring in the open flare, only for the biogas recovered and used for electricity generation. For this purpose, at least one biogas flowmeter and the biogas methane content analyzer will be installed in the derivation pipeline to engines.

No technological transfer from Annex 1 countries is involved in the development of the project activity. In case that any equipment were acquired in an annex 1 country, it will not involve a technological transfer since all the equipments and technologies to be used in the project activity are available in Brazil.

In the moment of redaction of the PDD, the technological providers confirmed where the following:

1. Geo-membranes to cover the anaerobic lagoons and transform them in biodigesters: *Avesuy*;
2. Biogas engines: *Biogas motores estacionários*: (www.biogasmotores.com.br);
3. Parshall flowmeter: *EchoTrek* or similar.
4. Physical chemical flotation tank: *Gratt Decanters Centrifugos*;
5. Centrifugal tri-decanter: *Gratt Decanters Centrifugos*;
6. Coagulation tank: *Gratt Decanters Centrifugos*;
7. Surface mixer: *Gratt Decanters Centrifugos*;
8. Evaporation tank: *Gratt Decanters Centrifugos*;

Environmental safety of the proposed project activity

The technology to be implemented at Cooperativa Lar industrial unit of chicken is very respectful with the environment. With the implementation of this project, the total amount of wastewater generated in the production process is treated in the plant and reused for irrigation (30%) and in the production process (70%).

Moreover, biogas emissions to the atmosphere are going to be drastically reduced to almost zero. The biogas produced will be used to generate electricity that will be consumed in the project activity and that could also be exported to the grid, contributing to reduce power consumption from the grid, required for operation of aeration equipment.

Apart from this, the designed treatment will reduce organic matter in treated water compared to the current treatment. Also, a tertiary treatment, which is out of the project boundary, will be implemented. This tertiary treatment will allow to reusing the treated water in the production process and in irrigation. By reducing the water consumption associated to the production process, Cooperativa Lar directly contributes to maintain the river's ecosystem. Thus, it is not only that the technology implemented in the proposed project is environmentally safe but also that contributes to improve environmental conditions in the nearby ecosystems and to reduce water consumption in the production process.

The technology implemented consists on the modification of the current treatment, in which only the outflow water discharge parameters are considered, to a different treatment concept in which water reuse, biogas recovery and utilization for renewable energy generation are considered and conform the pillars of the project activity. The environmental impact of these measures is limited to a foreseen increase in the electricity consumption due to the installation of new mechanical equipments.

In fact, Cooperativa Lar got the Environmental Licence for the development of the proposed project activity.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Year	**Estimation of annual emission reductions in tonnes of CO2 e**
November -December 2010 (both inclusive)	2,341
2011	20,239
2012	22,043
2013	22,043
2014	22,043
2015	22,043
2016	22,043
2017	22,043
2018	22,043
2019	22,043
Jan-October 2020 (both inclusive)	18,369
Total estimated reductions (tonnes of CO2 e)	217,293
Total number of crediting years	**10**
Annual average of the estimated reductions over the crediting period (tCO_2 e)	**21,729**

A.4.4. Public funding of the small-scale project activity:

The proposed project activity is being partially financed with own resources and with funds from Financiadora de Estudos e Projetos (FINEP).

FINEP[3] is a Federal Funding company created in 1967 and subordinated to the Ministry of Science and Technology of Brazil. FINEP[4] encourages and finances the innovation and scientific-technological research in universities, companies, technological centres, research and development institutes or other public or private institutions. For this purpose, FINEP mobilizes financial resources and other tools to promote social and economic development in Brazil.

FINEP, through the National Fund for Scientific and Technological Development (Fundo Nacional de Desenvolvimento Científico e Tecnológico, FNDCT) has partially financed the implementation of the first stage of the proposed project activity as a part of the "Programa de Geraçao Distribuida" (Decentralized Power Generation Programme). The funds granted by FINEP are allocated for the bio-digesters construction and the acquisition of biogas engines. The investment corresponding to any other activity in the project boundary is faced directly by Cooperativa Lar.

Out of the total investment for the implementation of the project activity, over 5 million *reais*[5], FINEP finances the 17.9%. Cooperativa Lar will face the remaining investment with equity capital, reaching more than 82.1% of the total investment.

The National Fund for Technological and Scientific Development (FNDCT)

The FNDCT is a fund from FINEP focused on specific areas and programmes. The support from FNDCT is focused on research programmes, human resources and training, technology transfer projects.

Cooperativa Lar is involved in a pilot project for decentralized power generation with other R&D and related companies. In 2006, this group of companies started the development of the "Decentralized Power Generation Programme", aimed in the biogas recovery in different industries to use it as an energy source for power generation for self consumption and exportation to the grid.

One of the identified barriers for the implementation of this project was the access to financial funds.

[3] **FINEP**. http://www.finep.gov.br//english/folder_ingles.pdf
[4] **FINEP.** http://www.finep.gov.br/o_que_e_a_finep/a_empresa.asp?codSessaoOqueeFINEP=2
[5] 1 BRL = 0.556784 USD. Rates at 23/09/2009. http://www.xe.com/ucc/convert.cgi

In august 2006 and with the aim of applying for financial aid from FINEP, Cooperativa Lar developed together with the below mentioned entities a document regarding the “Programa de Geraçao Distribuida” (Decentralized Power Generation Programme).

- Companhia Paraenense de Energia – COPEL
- Itaipu Binacional
- Companhia de Saneamento do Estado do Paraná – SANEPAR
- Cooperativa Agroindustrial Lar
- Instituto Ambiental do Paraná – IAP
- LACTEC

This document, signed by all the participant entities, was submitted to FINEP for funding application, at the end of 2006. After submission of this application, FINEP had to analyse the proposed project and finally issue the definitive approval or rejection of the proposal for financing. The definitive approval from FINEP for financial aid was received on 15/05/2008. On this date, the contract between FINEP and Instituto de Tecnologia Aplicada e Innovaçao – ITAI, was signed to partially finance the “Programa de Geraçao Distribuida com Saneamento Ambiental” (Contractual Code: 0/1/08/0159/00)

Since FINEP financing is not from Annex-1 parties, this is not considered an Official Development Assistance.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM projects activities, debundling is defined as the fragmentation of a large project activity into smaller parts. A proposed small-scale project activity that is part of a large scale project activity is not eligible to use the simplified modalities and procedures for small scale CDM project activities. The full project or any component of the full project activity shall follow the regular CDM modalities and procedures.

A proposed small scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Which project boundary is within 1 km of the project boundary of the proposed small-scale CDM project activity at the closest point.

Since the project activity does not correspond to any of the above-mentioned points, it shall not be considered de-bundled component of a larger project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The project activity applies three approved baselines and monitoring small scale methodologies:

1. AMS III.H. "Methane Recovery in Wastewater Treatment". Version 13. Sectoral scope: 13.
2. AMS III.I. "Avoidance of Methane Production in Wastewater Treatment through Replacement of Anaerobic Systems by Aerobic Systems". Version 08. Sectoral Scope: 13.
3. AMS I.D. "Grid Connected Renewable Electricity Generation". Version 15. Sectoral scope: 01.

Apart from the above mentioned methodologies, the project also applies the following tools:

1. Tool to calculate the emission factor for an electricity system, Version 02;

B.2 Justification of the choice of the project category:

The proposed project activity meets all the applicability criteria and conditions of the above mentioned small scale methodologies, as described below:

Applicability conditions for AMS.III-H "Methane Recovery in Wastewater Treatment"

Applicability Condition	Project Case
This project category comprises measures that recover methane from biogenic organic matter in wastewaters by means of one of the following options: … (vi) Introduction of a sequential stage of wastewater treatment with methane recovery and combustion, with or without sludge treatment, to an existing wastewater treatment system without methane recovery (e.g. introduction of treatment in an anaerobic reactor with methane recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).	The Project involves the introduction of an anaerobic digestion stage with methane recovery to the existing wastewater treatment – an open anaerobic lagoon system without methane recovery. Methane will be combusted as an energy source for electricity generation and excess generated methane will be flared in a safety torch.
The recovered methane from the above measures may also be utilized for the following applications instead of combustion/flaring: (a) Thermal or electrical energy generation directly;	The recovered methane is used for electricity generation in the project activity. Excess biogas will be flared in a safety open torch.

Applicability Condition	Project Case
If the recovered methane is used for project activities covered under paragraph 2 (a), that component of the project activity can use corresponding category under type I.	The project activity involves an energy generation system that produces electricity from generated biogas; hence, it's also eligible under category AMS.I.D.
Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually.	The emission reductions estimated for the proposed project activity are 21,729 tCO_{2e} per year. Therefore, the Project activity will result in less that 60kt CO_2 equivalent annually.

Applicability conditions for AMS.III-I "Avoidance of Methane Production in Wastewater Treatment through Replacement of Anaerobic Systems by Aerobic Systems"

Applicability Condition	Project Case
This methodology comprises technologies and measures that avoid the production of methane from biogenic organic matter in wastewaters being treated in anaerobic systems. Due to the project activity, the anaerobic systems (without methane recovery) are substituted by aerated biological systems The activity does not recover of combust methane in wastewater treatment facilities.	The project activity consists of the replacement of the existing wastewater treatment – anaerobic lagoons without methane recovery – with an aerated treatment in a physical-chemical flotation tank and three aerated lagoons. The inflow wastewater, which in the absence of the project activity would have been treated in anaerobic lagoons, is treated in these new aerated tanks, thus avoiding the generation of methane.

Applicability of AMS.III.I is limited to some treatment systems in the project scenario (see section B.3, "Description of the Project Boundary"). Unlike AMS.III.H, the SSC methodology AMS.III.I does not consider the recovery of methane and its combustion in the treatment facilities. However, the systems affected by AMS.III.I do not recover methane neither combust it. Methane recovery only takes place in the existing first and second open anaerobic lagoons, which are covered. These lagoons are under AMS.III.H in the project scenario. Apart from this, methane combustion takes place in the engines installed for this purpose. This combustion is under AMS.I.D as per the procedures described in AMS.III.H.

Applicability conditions for AMS.I-D "Grid connected renewable electricity generation"

Applicability Condition	Project Case
Measures are limited to those that result in emission reductions of less than or equal to 60 $ktCO_2$ equivalent annually.	The emission reductions estimated for the proposed project activity are 21,729 tCO_{2e} per year. Therefore, the Project activity will result in less that 60kt CO_2 equivalent annually
This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	The project will generate electricity from capture methane and will use this electricity for internal purposes to displace electricity from the grid. Electricity could also be exported to the grid.
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology (…)	Not applicable
If the unit added has both renewable and non renewable components (e.g.. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel1, the capacity of the entire unit shall not exceed the limit of 15MW.	The installed generation power will be 160 kW Therefore, the Project activity will result in less that 15 MW, the elegibility limit for a small-scale CDM project. However, in case that Cooperativa Lar considered the installation of additional biogas engines. In this case, a modification of the PDD would be applied as per the Annexes 66 & 67 of EB48.
Biomass combined heat and power (co-generation) systems that supply electricity to and/or displace electricity from a grid, are included in this category.	Not applicable
In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not applicable
Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	Not applicable

B.3. Description of the project boundary:

According to the applicable methodologies, the project boundary is defined as follows:

- As per AMS.III-H/Version 13, for the methane capture part of the project, "the project boundary is the physical, geographical site where the wastewater and sludge treatment takes place in baseline and project situation. It covers all facilities affected by the project activity including sites where the processing, transportation and application or disposal of waste products as well as biogas takes place.
  Implementation of the project activity at a wastewater and/or sludge treatment system will affect certain sections of the treatment systems while others may remain unaffected. The treatment systems not affected by the project activity, i.e. sections operating in the project scenario under the same operational conditions as in the baseline scenario (e.g. wastewater inflow and COD content, temperature, retention time, etc.), shall be described in the PDD, but emissions from those sections do not have to be accounted for in the baseline and project emission calculations (since the same emissions would occur in both baseline and project scenarios). The assessment and identification of the systems affected by the project activity will be undertaken ex ante, and the PDD shall justify the exclusion of sections or components of the system. The treatment systems (lagoons, reactors, digesters, etc.) that will be covered and/or equipped with biogas recovery by the project activity, but continue to operate with the same qty. of feed inflow, volume (retention time), and temperature (heating) as in the baseline scenario, may be considered as not affected i.e. the methane generation potential remains unaltered.".

- As per AMS.III-I/Version 08, for methane production avoidance, "the project boundary is the physical, geographical sites where:
  - The wastewater treatment would have taken place and the methane emission occurred in the absence of the project activity;
  - The wastewater treatment takes place in the project activity;
  - The sludge is treated and disposed off in the baseline and project situation"

- As per AMS.I-D/Version 15, for the electricity generation part of the project activity, "the physical, geographical site of the renewable generation source delineates the project boundary".

The equipment included in the project boundary in both stages is shown in the schemes below.

Baseline and first stage of implementation.

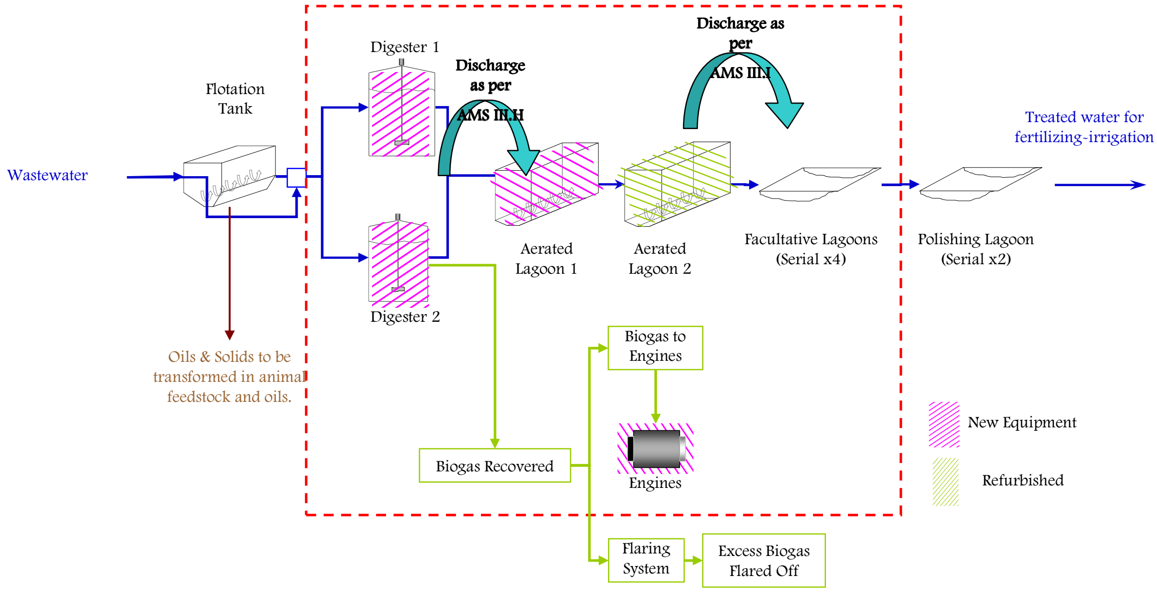

Fig. 6. Equipment included in the project boundary in Stage 1 of implementation. New equipment are the biodigesters and the first aerated lagoon, which in the baseline were open anaerobic lagoons. The aerated lagoon named "Aerated Lagoon 2" is the existing aerated one with the required aeration equipment to reach a proper aeration. Discharge pathway from the biodigesters (applying AMS.III.H) is the new aerated lagoon 1 (well managed) and discharge pathway from the aerated treatment stage (which applies AMS.III.I) is the existing facultative lagoon 1, which is more conservative that considering the discharge pathway at the aerated lagoon 2, which is refurbished and, hence, well managed. . The PP is only claiming for the ER resulting from the destruction of methane in the biogas engines. The recovered biogas will be sent to the engines or, in case that combustion in engines was not possible, biogas will be directed to the flaring system. The PP is not accounting the ER resulting from biogas flared in the safety torch, which is the same than considering that flaring efficiency was zero in the flaring system. According to this assumption, the biogas which is not combusted in the engines for power generation is assumed to be released to the atmosphere, in a conservative approach, although it will actually be combusted in the flare. Thus, biogas flaring system in safety open flare is out of the project activity.

Although the project registration is expected to happen together with the implementation of stage 2, the PPs have considered convenient to include the explanation in the PDD of how would the first stage of implementation be considered in accordance with the applicable methodologies, taking into account that the whole project activity has been configured to start reducing GHG emissions from the first stage of implementation.

Hence, both stages of implementation are explained, despite the fact that calculations of emissions reductions only consider the second stage, which is the configuration that would actually be operating when the project gets the registration status.

The systems affected by the methodology AMS.III.H in the first stage of implementation are:

1. The first and second existing anaerobic lagoons, which in the baseline scenario are open lagoons. In the project scenario, these lagoons are covered and lined and biogas is recovered to be combusted in the biogas engines and/or flared in the safety torch.
    a. Paragraph 14 of the methodology mentions the following:
    The treatment systems not affected by the project activity, i.e., sections operating in the project scenario under the same operational conditions as in the baseline scenario (e.g., wastewater inflow and COD content, temperature, retention time, etc.), shall be described in the PDD, but emissions from those sections do not have to be accounted for in the baseline and project emission calculations (since the same emissions would occur in both baseline and project scenarios).
    In the first stage of implementation, these two existing anaerobic lagoons are lined and covered for methane recovery and are also equipped with agitation systems. According to the applicability criteria of the methodology, *"this methodology comprises measures that recover biogas from biogenic organic matter in wastewaters by means of"* (paragraph 1.vi) *"Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an existing anaerobic wastewater treatment system without biogas recovery"*. Hence, the covering and lining of the two existing anaerobic lagoons for biogas recovery, as it happens in the project activity, is in accordance with the applicability criteria.
    In paragraph 14 of the methodology, it is mentioned that *"the treatment systems (lagoons, reactors, digesters, etc.) that will be covered and/or equipped with biogas recovery by the project activity, but continue to operate with the same qty. of feed inflow, volume (retention time), and temperature (heating) as in the baseline scenario, may be considered as not affected i.e., the methane generation potential remains unaltered"*. The existing anaerobic lagoons in the baseline scenario, operate in the first stage of implementation with the same flow, the same volume (retention time) and temperature (since there is no heating in the project). However, agitation systems are introduced in the biodigesters. These agitation systems, in the baseline scenario, would interfere the anaerobic conditions in the baseline situation (open lagoons) and would affect the treatment conditions. In the project situation, where lagoons are lined and covered, agitation systems avoid the formation of grease layers in the water. These layers, which appear in the baseline situation, would be inconvenient in the project scenario, in which the aim of the PPs is to recover all the biogas generated. Hence, in fact, the treatment conditions and the equipment installed in the project scenario affect the treatment systems (existing anaerobic open lagoons) and, thus, these are affected by the project activity.
2. The biogas engines, in which biogas recovered is combusted for electricity generation.

The systems in which the wastewater treatment would have taken place and the methane emission occurred in absence of the project activity, in the first stage of implementation according to AMS.III.I version 08 are:

1. The third existing anaerobic open lagoon, which in the baseline scenario is an open lagoon without biogas recovery. In the project scenario, this lagoon is reequipped and modified to an aerated lagoon;
2. the first existing aerated lagoon, which in the baseline scenario is poorly managed and in the project scenario is well managed;

In the baseline, there is not a separated sludge treatment operating in the wastewater treatment plant at Cooperativa Lar. Before entering the project boundary, chicken parts, feathers and other sizeable solids are removed from water inflow. This separation is also done in the baseline situation. Sludge resulting from the biological decomposition of organic matter flows together with water to the facultative lagoons and the polishing lagoons. According to the methodology, since these lagoons are not affected by the project activity and they are in the project scenario under the same operational conditions as in the baseline scenario, *they shall be described in the PDD,* but emissions from those sections do not have to be accounted for in the baseline and project emission calculations.

In these lagoons, wastewater arrives with a low concentration of organic matter which has already lost most of the biological activity and, thus, does not suffer an intense decomposition. The COD and the BOD_5 are low enough to ensure a low organic activity.

Moreover, with the implementation of the first stage of the project, water reaches the facultative lagoons with a lower organic load, leading to a lower biological activity and methane emissions. However, in order to be conservative and since the facultative and polishing lagoons are not affected by the project, the PP has considered that emissions in them are the same than in the baseline.

Water containing these deactivated sludge is very nutritive for plants and, hence, is used for fertilizing irrigation for the nearby zone in which eucalyptus grow. In the first stage of implementation there is no separation nor any modification of this final step in the wastewater treatment. The only possible change from the baseline is that water arriving to polishing lagoons will very probably have a lower organic load than in the baseline. This water rich in deactivated organic matter will be used for fertilizing-irrigation

Regarding the biogas flare, the project proponent is not applying for the emission reductions resulting from the flaring of biogas in the safety torch, only for those occurring in the biogas fed engines.

The project proponent will install a safety torch for safety reasons. Excess biogas which will not be combusted in the engines for power generation, will flow to the torch and will be flared there.

In order to be conservative, the project proponent will consider that only the biogas feeding the engines and used for power generation is destroyed, since this is the actual aim of the Decentralized Power Generation Programme and, thus, the aim of the biogas recovery process.

In accordance to the above and regarding the GHG emissions, *processing, transportation and application or disposal of biogas* takes place only in the engines. Whatever happens with the excess biogas, recovered not used for power generation, the PP will consider that it was released to the atmosphere. However, as explained before, the safety torch will flare the excess biogas not combusted in the engines, thus being this approach very conservative in terms of GHG emissions.

According to paragraph 36 of the methodology, the amount of biogas recovered, fuelled, flared or utilized shall be monitored ex post, using continuous flow meters. The PP, since is not considering the emissions reduction from biogas flaring in the open flare in the ER calculations, will only monitor the biogas directed to and combusted in the engines. According to this and to the explanation above, the open flare for excess biogas remains out of the project boundary.

Second stage of implementation

In the second stage of implementation there is a separated treatment for solid matter from the PCF tank. This treatment is not a sludge treatment since it is a physical separation, without settling processes or biological activity. Chicken parts, feathers and other sizeable solids are removed from water inflow before entering the wastewater treatment. This separation is also done in the baseline situation and the first stage of implementation: sizeable solids from the slaughterhouse are separated from the wastewater flow at the flotation tank, before entering the anaerobic lagoons.

This solid matter removed from the inlet flow could be confused with primary sludge. However, according to the definition of sludge by the United Nations Environment Programme, Division of Technology, Industry and Economics, this confusion is not possible since there is no sedimentation process in the separation of this organic matter:

- Primary sludge: Sludge produced from primary treatment of wastewater.
- Primary treatment: The treatment of wastewater by screening and sedimentation to remove solids[6].

Sizeable solids and feathers are separated in the physical-chemical flotation tank but do not pass through any sedimentation process. Other references[7],[8] support that the removal of these solids is not in the scope of the concept of sludge.

This untreated solid matter is sent to an evaporation tank in which water is partially evaporated and, after, to the new centrifuge three phase decanter.

The three phase centrifugal decanter separates the mixture of light liquid phase, heavy liquid phase, and solids through the application of centrifugal forces.

[6] **United Nations Environmental Programme. Division of Technology, Industry and Economics.**
http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-15/glossary_2.asp

[7] **EIMCO Water Technologies. Municipal Wastewater Division. Sludge treatment.**
http://www.eimcowatertechnologies.com/muniint/index.php?option=com_content&view=article&id=101&Itemid=105

[8] **AAQTIC: Asociación Argentina de los Químicos y Técnicos de la Industria del Cuero. (Argentina Association of Chemicals and Technicians in the Leather Industry). Istanbul Congress 2006**.
http://www.aaqtic.org.ar/congresos/istanbul2006/Visual%20Displays/V%2025%20-%20Cost%20evaluation%20of%20sludge%20treatment%20options%20and%20energy%20recovery%20from%20wastewater%20treatment%20plant%20s.pdf

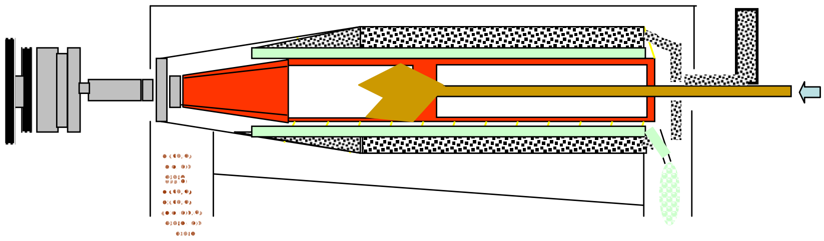

Fig. 7. Scheme of a three phase decanter. Source: Own elaboration.

The inlet matter is separated in three phases (solid, light liquid phase and heavy liquid phase) by means of the application of continuous centrifugal forces. Solid phase is delivered to the rotor and to the helicoidal transportation screw, and clarified liquid phase is evacuated in two different phases: heavy and light liquid phases. The solid phase, already dehydrated, is used as animal feedstock, as in the current situation.

There is no settling phenomenon in this process although the equipment is called three phase decanter and could be confusing.

Since there is no settling or sedimentation process involved in the removal of the solid matter in the physical-chemical flotation tank, this separated solid matter cannot be considered as sludge, not even primary sludge.

Moreover, Cooperativa Lar, in the baseline scenario, is already separating solids and oils in the initial stage of the treatment. This, in the baseline situation, occurs in the existing flotation tank and was checked during the site visit. The main difference is that, in the project situation, Cooperativa Lar improves the separation process by the installation of a three phase decanter. Hence, the removal and separation of this matter, which also happens in the baseline scenario in the flotation tank, is clearly out from the project boundary.

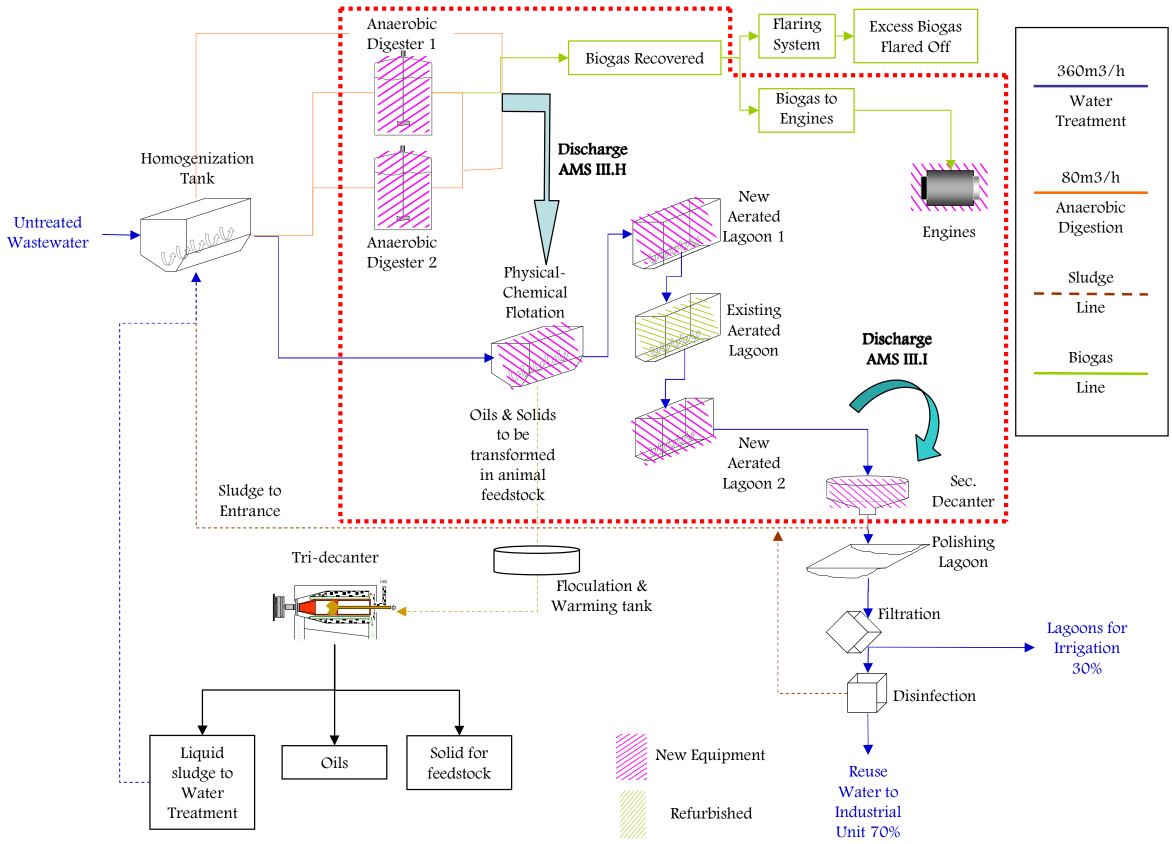

Fig. 8. Equipment included in the project boundary in Stage 2 of implementation. New equipments are the biodigesters, the physical-chemical flotation tank, the aerated lagoons (2 of three), the decantor and the biogas recovery system and engines. The aeration system (PCF Tank and three serial aerated lagoons) displace the anaerobic system from the baseline. Discharge pathway from the biodigesters (applying AMS.III.H) is the new PCF tank, aerated and well managed, since the retention time in the homogenization tank is very little. Discharge pathway from the new aerated system is the new decanter, which behaves as an anaerobic lagoon with depth over 2m. Biogas flaring system in safety open flare is out of the project activity.

The sludge generated from the wastewater treatment appears in the settling process in the secondary decanter. It is extracted from the bottom of the decanter and re-directed to the homogenization tank, where it meets the wastewater inlet, not being treated separately. The reason of re-pumping this sludge is to enhance the biological activity of bacteria in wastewater, which is necessary for a proper organic matter removal in the aeration lagoons. Apart from this sludge, after the disinfection process, some amount of sludge is generated. This is also sent to the initial stage of the wastewater treatment and no specific sludge treatment is required. Hence, this sludge is not treated or disposed off in the project situation. The decanter, since it will be modified by the project activity and is a discharge pathway, is included in the project boundary.

After the decanter, the new water treatment for water reuse and irrigation is not a part of the project activity since there is no GHG emission reduction associated. However, the tertiary treatment of water has a clear environmental friendly target, which consists on the reuse of 70% of the water used in the production process of chicken. With this tertiary treatment, Cooperativa Lar will drastically reduce the amount of water consumption from the river, thus contributing to improve the environmental atmosphere in the region.

The systems affected by the methodology AMS.III.H in the second stage of implementation are:

1. The first and second existing anaerobic lagoons, which in the baseline scenario are open lagoons. In the project scenario, these lagoons are covered and lined and biogas is recovered to be combusted in the biogas engines and/or flared in the safety torch.
   Apart from this, the wastewater flow in these lagoons is, in the second stage of implementation, less than in the baseline scenario (only 80m3/h out of the whole water flow). Hence, according to the applicability criteria of the methodology (paragraph 1,vi) these systems are covered under AMS.III.H.
2. The biogas engines, in which biogas recovered is combusted for electricity generation,

The systems in which the wastewater treatment would have taken place and the methane emission occurred in absence of the project activity, in the second stage of implementation according to AMS.III.I are:

1. The third existing anaerobic open lagoon, which in the baseline scenario is an open lagoon without biogas recovery. In the project scenario, this lagoon is reequipped and modified to an aerated lagoon;
2. the first existing aerated lagoon, which in the baseline scenario is poorly managed and in the project scenario is well managed;
3. The first existing facultative lagoon, with a depth over 2m, which in the baseline scenario behaves as an open anaerobic lagoon. In the project scenario, this lagoon is modified and equipped to operate as an aerated lagoon.
4. The new physical-chemical flotation tank, which in the project scenario operates before the aeration lagoons.

B.4. Description of baseline and its development:

Baseline scenario

Before the implementation of the proposed project activity, Cooperativa Lar has been treating wastewater produced from the Industrial Unit of Chicken in anaerobic open lagoons, accomplishing the Brazilian regulation, and consuming the required electricity for the operation of the plant from the grid. The wastewater treatment consisted in three serial anaerobic lagoons without any equipment of agitation or aeration, an aerated lagoon poorly aerated and facultative and polishing lagoons. The volume of these anaerobic lagoons allows water to stay under anaerobic conditions for enough time, thus helping the anaerobic decomposition of wastewater to occur. Moreover, the fat cover which is formed over wastewater in anaerobic lagoons after a little time, also avoid external air (and thus oxygen) to mix with wastewater, making the anaerobic conditions in water more severe.

Anaerobic treatment of wastewater in open lagoons does not require special features and results in acceptable treated water discharge loads. Equipment to be installed in lagoons is almost nil and operation of this treatment is very simple. Waste water entries the lagoon, stays the so-called retention time, suffers the anaerobic decomposition of organic matter and exits the lagoon. Hence, ensuring enough retention time is sufficient to control the COD removal in the anaerobic treatment in open lagoons.

When exiting the anaerobic open lagoons, the water stream flows to the existing aerated lagoon, poorly managed in the baseline, and is discharged in the existing facultative lagoons.

Cooperativa Lar is planning to increase the production in the industrial unit of chicken. This will entail an increase in the wastewater flow to be treated. Obviously, if the water flow increases and no new lagoons are opened, the retention time will be reduced, not being sufficient to guarantee a proper[9] COD, SS and BOD_5 removal.

$$R_{time,(days)} = \frac{V_{lagoon,(m^3)}}{Q_{wastewater,(m^3/day)}}$$

Hence, with the plan of increasing the wastewater flow to be treated, the existing treatment system capacity would not be able to properly treat this surplus flow.

Hence, it is required to make a modification of the existing wastewater treatment in order to accomplish with the Brazilian regulation, which considers a maximum discharge load for wastewater that can be easily achieved by maintaining a minimum retention time to ensure the anaerobic degradation of organic matter in wastewater.

[9] COD: Chemical Oxygen Demand
BOD_5: Biological Oxygen Demand 5 days
SS: Suspended solids

According to paragraph 21 of the "Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories" version 14[10] (EB55, Annex 35), ***"Capacity increase:*** *Type II and III project activities involving capacity increase may use a Type II and Type III SSC methodology provided that they can demonstrate that the most plausible baseline scenario for the additional (incremental) capacity is the baseline provided in the respective Type II and III small-scale methodology. The demonstration should include the assessment of the alternatives of the project activity using the following steps:*

- *Step 1: Identify the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a DM project activity.*
- *Step 2: List the alternatives identified per step 1 in complicance with the local regulations (if any of the identified baseline is not in compliance with the local regulations, then exclude the same from further consideration).*
- *Step 3: Eliminate and rank the alternatives identified in step 2 taking into account barrier tests specified in attachment A to appendix B of simplified modalities and procedures of SSC CDM.*
- *Step 4: If only one alternative remains that is:*
    - *Not the proposed project activity undertaken without being registered as a CDM project activity; and*
    - *It corresponds to one of the baseline scenarios provided in the methodology; then the project activity is eligible under the methodology.*

  If more than one alternative remain that correspond to the baseline scenarios provided in the methodology, choose the alternative with less emissions as the baseline.

In accordance with the above guidelines and to demonstrate the additionality of the proposed project activity, project participants have applied the steps 1 to 4 indicated above.

[10] Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories. Version 14. http://cdm.unfccc.int/UserManagement/FileStorage/YXGI3TUH4EFSMROAWB5D81P7VJKC69

Apart from the application of the "*Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories*" version 14, two different technological providers have declared that the utilisation of anaerobic lagoons for effluent treatment in the poultry industry, is a common practice and thus the baseline scenario in the region of Paraná:

- Gratt Decanters, an experienced technological provider for aeration equipment for water treatment, a company with wide experience in the wastewater treatment in the State of Paraná, has corroborated that the common practice in the State of Paraná is the utilisation of anaerobic open lagoons for wastewater treatment from the effluents from poultry slaughterhouses. This declaration has been submitted to the validation team during the validation of this project.

- Together with this declaration, Avesuy, the technological provider of the bio-digestion systems, has also declared that the common practice for wastewater treatment in slaughterhouses in the State of Paraná, is the utilisation of anaerobic lagoons, in which organic matter is decomposed. This declaration has been also submitted to the validation team during the validation of the project.

Apart from this declaration, the Environmental Institute of Paraná (IAP) has also confirmed via email that the above mentioned is the common practice and thus, the baseline scenario in the State.

In addition to the above mentioned declarations and confirmations, project participants have explained in section B.5 that the project activity is not the common practice and hence cannot be considered as baseline scenario in Brazil, based on different references and documentation. Moreover, according to the National Inventory for GHG Emissions, (http://www.mct.gov.br/upd_blob/0004/4199.pdf), in the last years, the industrial wastes in the food industry, are being treated more and more in anaerobic reactors, due to the lower requirements of energy (since no aeration equipment is required).

In the poultry processing industry in Brazil, as it is explained in the barrier analysis, the most common treatment processes for wastewater are the anaerobic lagoons[11],[12], being a low tech and low cost technology[13],[14].

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[11] **"2006 IPCC Guidelines for National Greenhouse Gas Inventories".** Chapter 6. Wastewater Treatment and Discharge. Page 20.

[12] **Slaughterhouses: Bovine and Swine Industry,** Goverment of Sao Paulo. CETESB - Environmental Sanitation Technology Company & FIESP – Industries Federation of the State of Sao Paulo, 2008. *http://www.cetesb.sp.gov.br/Tecnologia/producao_limpa/documentos/frigorifico.pdf*

[13] **"Technical evaluation of a stabilization lagoons based system treating poultry effluents"** (Avaliaçao técnica de um sistema de lagoas de estabilizaçao tratando efluentes de frigorífico de frangos) *http://www.ufpel.edu.br/cic/2004/arquivos/conteudo_EN.html#01070*

[14] **Evaluation of operation in stabilization lagoons in wastewater treatment from slaughterhouse.** (Avaliacáo do desempenho de lagoas de estabilizaçao no tratamento de efluentes de matadouro). "***The stabilization lagoons are an extended method of waste treatment in industries which present, as a main characteristic, the high organic matter concentration***" *(As lagoas de estabilização são um método difundido no tratamento de despejos domésticos ou industriais que apresentem, como característica, grande concentração de matéria orgânica)*. Carlos Nobuyoshi Ide. ABES - Associação Brasileira de Engenharia Sanitária e Ambiental.

The National Methane Inventory for Waste Management in Brazil[15], mentions that the industrial effluents from food sector have been traditionally treated through lagoons or activated sludge systems or biological filters. Also, in the last years, the use of anaerobic reactors for industrial effluents treatment have increased strongly.

The Environmental Technology Company (CETESB) published in 2008 a report in which it is mentioned that the typical wastewater treatment in the swine and bovine industrial sectors, presents an structure in which the secondary treatment is based in stabilization lagoons, specially in anaerobic lagoons.[16]. Although this report refers specifically to swine and bovine sectors, this is extensible to the poultry processing industry, in case the wastes were treated through wastewater treatment. This is the case of Cooperativa Lar.

The Ministry of Environment in Brazil recognises two baseline scenarios for the treatment of manure from livestock farming:[17]:

1. "anaerobic lagoons" that are generally used in Brazil;
2. "anaerobic digesters", which are more advanced but rarely adopted;

Most of the slaughterhouses treating their effluents use biological processes as stabilization lagoons, anaerobic systems or activated sludge[18].

There are many examples of slaughterhouses in Brazil with wastewater treatments based on stabilization lagoons[19], [20],[21].

[15] **National Methane Inventory for Waste Management in Brazil. Volume 1, July, 1998. "Enabling Brazil to Fulfill its Commitments to the UNFCCC**) Alves, J. Manso, S.M. CETESB, 1998. Page 25. http://homologa.ambiente.sp.gov.br/proclima/publicacoes/publicacoes_portugues/inventario_de_residuos_brasil.pdf

[16] **"technical and environmental guidance on processing materials in slaughterhouses (bovine and swine)"** (Graxarias Processamento de Materiais de Abatedouros e Frigorificos Bovinos e Suínos. CETESB 2008. http://www.cetesb.sp.gov.br/Tecnologia/producao_limpa/documentos/graxaria.pdf

[17] **"Fiscal 2006 CDM/JI Project Research Swine Farms in the State of Santa Catarina, Brazil".** The Japan Research Institute. March, 2007.
http://gec.jp/gec/gec.nsf/3d2318747561e5f549256b470023347f/0af2af9a8f44acab4925730d002ebb86/$FILE/Summary_JapanResearch.pdf

[18] **"The potential reuse of water (treated effluents) in slaughterhouses",** (O Potencial de Reuso de Água (Efluentes Tratados) em um Matadouro-Frigorífico), João Pedro de Mello Forlani , Mônica Medeiros, Prof. M.Sc. Luis Fernando Rossi Léo. UNILIN. I Simposium of Environmental Engineering. (Anais do I Simpósio da Engenharia Ambiental).Page 83 & 85. http://www.eesc.usp.br/sea/sea2004/arquivos/Anais_-_SEA-2004.pdf

[19] **"Effluent management in poultry slaughterhouses: case study (super frango)"** (Gerenciamento de efluentes de abatedouros avícolas estudo de caso (super frango)). J.Fernandes Jr, O Mendes. Universidade Católica de Goiás – Departamento de Engenharia – Engenharia Ambiental AV. Universitária, nº 1440, Setor Universitário, Goiânia. ***"Stabilization lagoons are considered as one of the simplest technologies for wastewater treatment"*** *(As lagoas de estabilização são consideradas como uma das técnicas mais simples de tratamento de esgotos).*

[20] **"Evaluation of the treatment efficiency in wastewater treatment systems in slaughterhouses with stabilization lagoons and post-treatment in cultivated bed"** (Avaliaçao da eficiencia de sistemas de tratamento de efluentes de matadouro tratados por lagoas de estabilizaçao e postratamento em banhados artificiais de leitos cultivados). A.Garcia Arnal Barbedo, L.Marques Imolene, C.Nobuyoshi Ide, K.Francis Roche, J.Gonda.

Also the Federal University of Mato Grosso[22] mentions that the processes most largely developed in Brazil are the following, consisting on two stages:

- Preliminary: sieving for entrail removal, grease separation.
- Secondary: lagoons – use of a serial of **anaerobic, facultative and algae** lagoons.

Only in case that no space was available for the implementation of lagoons, the preliminary process would be completed with an equalization tank, a physical chemical flotation and a biologic treatment with activated sludge. However, the implementation of such treatment process would not happen if space was available to open new anaerobic lagoons, due to the higher operational and maintenance costs and the energy consumption associated to an aerated treatment.

If anaerobic lagoons are suitable to be the water treatment, this is, if there is space enough to open new anaerobic lagoons, the poultry processing industry would not consider any additional expenses and costs, nor any additional worries due to maintenance of equipment, lagoon cleaning, etc, related to the wastewater treatment. The only cost to be considered will be related to the excavation of new open lagoons which will allow to keep on treating wastewater as up to date.

Other references consider the anaerobic treatments for farming and agricultural wastes as the most interesting treatments in Brazil for wastewater and liquid waste treatment, increasing in the last years due to the significant advantages when compared with other treatment processes or composting process[23], [24], [25].

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[21] "*Ponds in which wastes are allowed to decompose over long periods of time and aeration is provided only by wind action. Sunlight is allowed to fall on sewage to purify it*". **Environmental Terminology and Discovery Service (ETDS), European Environmental Agency.** http://glossary.eea.europa.eu/terminology/concept_html?term=stabilisation%20lagoon

[22] **"Treatment and control of industrial effluents"**. Engo. Gandhi Giordano, D.Sc, Prof. Adjunto do Departamento de Engenharia Sanitária e do Meio Ambiente – UERJ Diretor Técnico da Tecma-Tecnologia em Meio Ambiente Ltda. *http://www.ufmt.br/esa/Modulo_II_Efluentes_Industriais/Apost_EI_2004_1ABES_Mato_Grosso_UFMT2.pdf*

[23] **"Paraná experience in wastewater treatment in small and medium scale"** (Experiência paranaense de tratamento de esgotos em pequena e média escala) Bollmann, Harry Alberto; Aisse, Miguel Mansur; Gomes, Celso Savelli.. Abstract. *http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&src=google&base=REPIDISCA&lang=p&nextAction=lnk&exprSearch=102936&indexSearch=ID*

[24] **"Evaluation of the anaerobic biodegrability of wastes in bovine and swine industry" (Avaliação da biodegradabilidade anaeróbia de resíduos da bovinocultura e da suinocultura).** LM. MoraesI; DR.Paula Jr. Eng. Agríc. vol.24 no.2 Botucatu May/Aug. 2004 ***"The interest for the anaerobic treatment of solid and liquid wastes from agriculture and agro-industry, has increased in the last years due to the significative advantages when compared with other common processes for wastewater aerobic treatment or the conventional composting of solid organic wastes treatment"*** *(O interesse pelo tratamento anaeróbio, de resíduos líquidos e sólidos provenientes da agropecuária e da agroindústria, tem aumentado nos últimos anos, por apresentar vantagens significativas quando comparado aos processos comumente utilizados de tratamento aeróbio de águas residuárias, ou aos processos convencionais de compostagem aeróbia de resíduos orgânicos sólidos).*

Reference: *http://www.scielo.br/scielo.php?pid=S0100-69162004000200025&script=sci_arttext*

[25] **"Systematization of technical and economical information about alternatives in wastewater treatment"** (Sistematizaçao de informaçoes técnicas e económicas sobre alternativas de tratamento de esgotos). Universidade de Sao Paulo. Núcleo de Pesquisa e Informaçoes Urbanas. Page 35. Table 2-7.

Application of the "Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories ", version 14 (EB55, Annex 35)

***STEP 1**. Identification of alternatives available with comparable level of service*

According to the applicable guideline, project participants shall *identify the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity.*

Cooperativa Lar, if did not develop the proposed project under CDM, would consider the following alternatives for the wastewater treatment modification:

1. Continuation with the existing treatment without making any modification.

    - This scenario is possible but not realistic since the existing treatment is not sized for a wastewater flow of $350m^3/h$. Organic load would not be properly removed due to short retention times and water would be discharged with high COD, SS and BOD_5.
    - Considering that the retention times would not be enough to remove enough organic matter, the alternative wastewater treatment would not deliver to the project proponent the same level of service as the proposed project activity. Hence, this alternative is not in compliance with the conditions established in the guidelines.
    - Despite the commitment of Cooperativa Lar with environmental friendly practices and the exemplarity in their processes, which would be deeply damaged in case that the water treatment would not be adequate, the discharge of treated water with high organic loads would involve health problems, soil pollution and odours that will obviously worsen the industrial plant hygienic conditions, the surroundings and will indirectly and directly affect the industrial production and Lar's product reputation, which is strongly bond to environmental care and excellence.
    - Electricity required for the operation of the plant would be purchased from the grid, since no electricity would be generated by the project activity.
    - As explained before, this scenario would not be realistic as a baseline scenario for the second stage of implementation nor in compliance with the conditions specified in the guidelines, since the level of service would not be comparable to the proposed project activity. Moreover, in the second stage of implementation the wastewater flow will increase up to $350m^3/h$, and hence, the retention time will decrease, so the effluent characteristics after the treatment would not be in compliance with the regulation.

2. Continuation with the current philosophy of wastewater treatment, based in anaerobic open lagoons and subsequent aerated, facultative and polishing lagoons and install new open anaerobic, facultative and polishing lagoons in the nearby zone in order to receive the increased wastewater flow and maintain the minimum retention time required for removing the same COD amount than in the current situation;

    - The land in the nearby zone to the industrial plant belongs to Cooperativa Lar. Thus, there is enough space to open new anaerobic lagoons. Moreover, Cooperativa Lar is sited at the upper part of a hill. Opening new lagoons would only require taking care of water flow (gravitational) from one lagoon to the next one.

- The treatment would be dimensioned in such a way that it would result in appropriate water discharge parameters, reaching the level of service comparable to the proposed project activity and required to be in accordance with the Brazilian regulation and not contributing to soil pollution, odour generation or health problems in the industrial plant. This scenario would constitute a continuation of the current wastewater treatment at Lar. According to Brazilian regulation[26], there is no obligation for Lar Agroindustries to change the wastewater treatment from anaerobic to aerated, nor to recover the generated biogas during anaerobic degradation of wastewater, nor to use that biogas as an energy source for electricity generation. Electricity required would be purchased from the grid.
- No additional training would be required for the O&M staff, who is already operating a treatment plant. Moreover, no mechanical equipment would be required to be installed in the lagoons and no electricity consumption and maintenance costs of equipment would rise up from the implementation of this alternative scenario.
- The major investment involved in the implementation of this alternative scenario is the excavation of the lagoons and the pipeline connection. Pipeline costs have not been considered however will not significantly change the result of the investment analysis.
- The knowledge and experience would facilitate Lar to operate and maintain this hypothetic scenario.
- As per the above mentioned reasons, this scenario is realistic and plausible to be considered an actual baseline scenario for the wastewater flow increase planned.
- It is a common practice the use of anaerobic lagoons for poultry processing industry[27], [28], [29], [30].

[26] **Law 9433/1997. National policy of Hydric Resources. Ministerio do Meio Ambiente.**
http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=370
Resoluçao 020/1986: Quality of effluents. Ministerio do Meio Ambiente.
http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=43
Hydric Resources: Regulation in the State of Paraná.
http://www.suderhsa.pr.gov.br/modules/conteudo/conteudo.php?conteudo=88

[27] "**2006 IPCC Guidelines for National Greenhouse Gas Inventories**". Chapter 6. Wastewater Treatment and Discharge. Page 20. *"The meat and poultry processing facilities typically em-ploy anaerobic lagoons to treat their wastewater"*

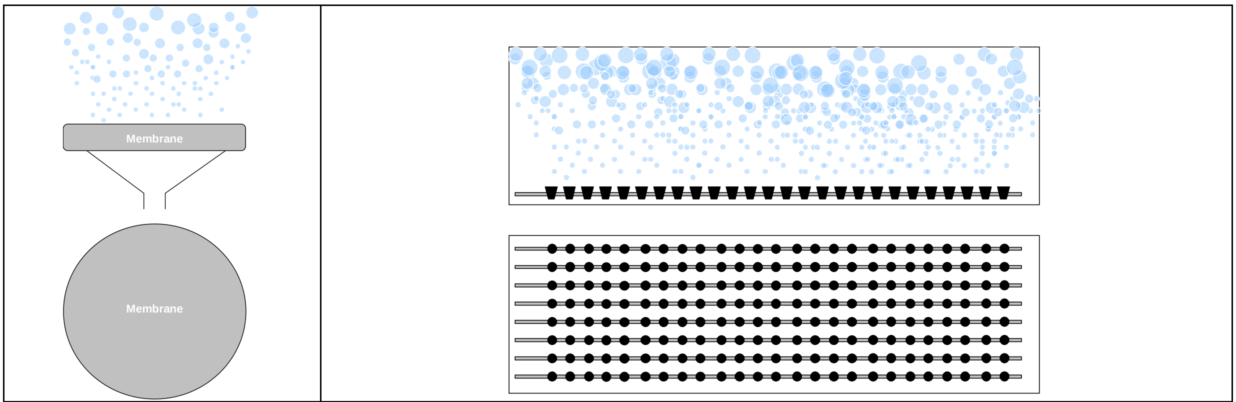
[28] **"Brazil Profile for Animal Waste Management"** Methane to Markets Agriculture Subcommittee, December, 2006 "Currently, anaerobic lagoons correspond to the baseline for CDM projects based on mitigation of greenhouse gases from animal wastes management systems" *http://www.methanetomarkets.org/resources/ag/docs/brazil_profile.pdf*

[29] **"Fiscal 2006 CDM/JI Project Research Swine Farms in the State of Santa Catarina, Brazil".** The Japan Re-search Institute. March, 2007. *"Identification of alternative scenarios for proposed CDM project activities: there are two alternative methods that can be consid-ered, namely the "anaerobic lagoons" that are generally used in Brazil, and "anaerobic digesters", which are more advanced but rarely adopted. (...) Barrier Analysis: Substantial investment is needed for anaerobic digesters, and detailed monitoring and sys-tem maintenance need to be performed. On the other hand, anaerobic lagoons represent simple and inex-pensive technology, with straightforward operation and maintenance. Anaerobic lagoons should be installed as the baseline scenario from the perspective of both in-vestment and technological barriers".*
http://gec.jp/gec/gec.nsf/3d2318747561e5f549256b470023347f/0af2af9a8f44acab4925730d002ebb86/$FILE/Summary_JapanResearch.pdf

[30] **"Treatment and control of industrial effluents".** Engo. Gandhi Giordano, D.Sc, Prof. Adjunto do Departamento de Engenharia Sanitária e do Meio Ambiente – UERJ Diretor Técnico da Tecma-Tecnologia em Meio Ambiente Ltda. http://www.ufmt.br/esa/Modulo_II_Efluentes_Industriais/Apost_EI_2004_1ABES_Mato_Grosso_UFMT2.pdf

3. Installation of aeration equipment in the existing anaerobic lagoons:

   - Considering that the wastewater flow will be increased in more than double than the current flow and avoiding the excavation of new lagoons, the aeration equipment to be installed would have to develop aeration efficiency high enough to properly remove the organic load in wastewater in a very short time.
   - This kind of aeration can only be reached with micro bubble diffusers installed in the bottom of the lagoons. The configuration of the micro bubble diffusers is shown below:



Detail of diffuser	Lagoon configuration

Fig. 9. Lagoon configuration with microbubble difussers and detail of the diffuser.

- The installation of these diffusers not only involve the investment in the pipeline structure and the microbubbles diffusers, which would be quite high, but also involves a more complex operation than the anaerobic lagoons and operational costs that, in that case, would not occur.
- Micro bubble diffuser pipeline has to be connected to blowers. These blowers, which are basically air compressors, consume an amount of power that, in the case of anaerobic treatment, would not occur.
- No methane would be generated in the treatment and electricity required would keep on being purchased from the grid.
- Apart from this, the maintenance of a micro bubble diffuser is quite complex. The membranes covering the steel structure are quite delicate. If one membrane breaks or is blocked, it has to be changed in order to maintain a regular and equal air diffusion in wastewater. The main drawback of the replacement is that the lagoon has to be emptied almost completely, at least until the pipeline depth. This means that the water treatment must stop completely or that wastewater flow has to be diverted to the following lagoon, thus reducing the treatment efficiency.
- There is no reason for Lar to get involved in such an initial investment, higher expected O&M costs and possible operational problems that are avoidable by means of implementing a treatment based on anaerobic open lagoons which is well known, requires almost only an initial investment and which is affordable by the company since the required space is available.

- From the Project Proponent's point of view, the level of service is not comparable. The operation of this treatment system is much more complex than the anaerobic lagoons, thus requiring from the Project Proponent more resources for the operation and maintenance. The result of this treatment, however, would not differ much from the treatment with anaerobic open lagoons. Hence, despite the fact that the wastewater treated would meet the minimum requirements under Brazilian regulation for disposal, for the Project Proponent, this alternative cannot be considered an available alternative since the operation and the maintenance are not comparable with those in an anaerobic lagoon system.
- As per the above explained reasons, the installation of high efficiency aeration equipment in the existing lagoons cannot be considered a plausible nor realistic alternative baseline scenario available for the Project Proponent.

4. Implementation of the project activity without the CDM:

   a. The proposed project activity implies the installation of geomembranes in two of the existing anaerobic open lagoons, the installation of agitation equipment in these lagoons for efficiency increase, the biogas recovery for electricity generation, the installation of biogas fired engines, the construction of a high efficiency aerated new tank (Physical Chemical Flotation tank) with micro bubble aeration and the installation of new aeration equipment for the two new aerated lagoons and the refurbished existing aerated lagoon.
   b. The compensation received by Cooperativa Lar for the implementation of the above mentioned measures is only, in the absence of the project activity, the generation of power from biogas combustion in the specific engines. However, power consumption would also increase due to aeration equipment installed and operation and maintenance procedures would become more complex and their cost would increase. (see explanation in point 3).
   c. With the recovery of biogas in biodigesters, Cooperativa Lar could use this biogas as a source of energy for electricity generation. However, the incomes due to the sale of electricity to the grid and the savings due to electricity generation, would not be enough attractive for Lar to decide implementing the project activity, as it is shown in the investment comparison analysis below.
   d. Hence, there is no reason for Lar, in the absence of the CDM benefits, to get involved in this project instead of continuing with the existing, known treatment in anaerobic open lagoons, which is clearly plausible, suitable and possible. The investment comparison analysis in section B.5 explains in detail how Cooperativa Lar has no incentive to develop the proposed project activity in the absence of the CDM. However, this is an available alternative with the same level of service as the anaerobic lagoons system including the increase of lagoons to the Project Proponent.

***STEP 2**: List the alternatives identified per step 1 in compliance with the local regulation (if any of the identified scenarios is not in compliance with the local regulations, then exclude the same from further consideration)*

As explained in Step 1, the proposed alternatives 1 and 3 would not deliver a comparable level of service to the project proponent. Moreover, the first one, i.e. the continuation with the existing treatment without doing any modification, would not be in accordance even with the Brazilian regulation. The retention time in the existing treatment is not enough to treat the wastewater properly and the COD removal would not be enough to be in compliance with the Brazilian regulation when water flow increases. Hence, this scenario is not a realistic alternative.

Out of the other two alternative scenarios identified as with a comparable level of service, both of them will be in accordance with the legal and regulatory requirements in Brazil.

Outcome of Steps 1&2: *List of alternatives available to the Project Proponent with the same level of service and in compliance with mandatory legislation and regulations.*

As per the explanation above, the available alternative scenarios that will deliver a similar and comparable level of service to the Project Proponent and would be in accordance with the Brazilian regulation, would be the following two:

1. the **continuation of the wastewater treatment, based in anaerobic open lagoons and subsequent aerated, facultative and polishing lagoons as well as the construction of new open anaerobic, facultative and polishing lagoons in the nearby zone in order to receive the increased wastewater flow and maintain the minimum retention time required for removing the same COD amount as in the current situation. In this baseline situation, no electricity would be generated from renewable sources since no biogas would be recovered. Electricity required for the operation of the plant, would be purchased from the grid, as before, which is in accordance with AMS.ID.**

2. The proposed project activity without being registered under CDM.

STEP 3: Barrier analysis

The barrier analysis is **discussed in detail in section B.5**. This barrier test will show that the implementation of the proposed project activity without being registered under CDM is prevented by different and solid barriers. Hence, there is only one alternative baseline scenario, which is, after the application of steps 1 to 3 of the guidelines, not the proposed project activity undertaken without being registered under CDM.

According to step 4 of the guidelines, the identified baseline shall correspond with the baseline scenario provided in the methodology.

AMS.III.H does not define specifically the baseline scenario. This baseline is established according to the applicability criteria (systems affected) and to paragraph 15 of the methodology (Wastewater and

sludge treatment systems equipped with biogas recovery facility in the baseline situation shall be excluded from the baseline emission calculations).

According to AMS.III.I, *"the baseline scenario is the situation where, in the absence of the project activity, degradable organic matter in wastewater is treated in anaerobic systems and methane is emitted to the atmosphere"*. The PPs have elaborated the baseline scenario analysis before based on the respect of this premise, by identifying the possible, realistic and plausible alternatives to the CDM project activity. After the identification, the PPs have established which are the systems affected by the project activity and what is the situation in the absence of the project, as per the applicable methodologies.

In the absence of the project activity, the electricity required in Lar's facilities would be taken from the grid. This means that all project electricity generation would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in section B.6. The CM consisting of the combination of operating margin (OM) and build margin (BM) is as per paragraph 11 (a) of AMS I.D. version 15, calculated according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system" version 02 (EB50, Annex 14).

Outcome of steps 3 & 4: baseline scenario.

After applying the barrier test (in detail in section B.5), the only alternative baseline scenario is identified as:

> the **continuation of the wastewater treatment, based in anaerobic open lagoons and subsequent aerated, facultative and polishing lagoons as well as the construction of new open anaerobic, facultative and polishing lagoons in the nearby zone in order to receive the increased wastewater flow and maintain the minimum retention time required for removing the same COD amount as in the current situation. In this baseline situation, no electricity would be generated from renewable sources since no biogas would be recovered. Electricity required for the operation of the plant, would be purchased from the grid, as before, which is in accordance with AMS.ID version 15.**

Considering this baseline scenario and the effluent loads in the current situation, the project proponent has considered that, when the water flow increases, the COD removed in the *"anaerobic open lagoon system"* is the same that in the current situation.

The diagram below shows schematically the wastewater current treatment at Lar's Industrial Unit of Chicken, which constitutes the baseline scenario.

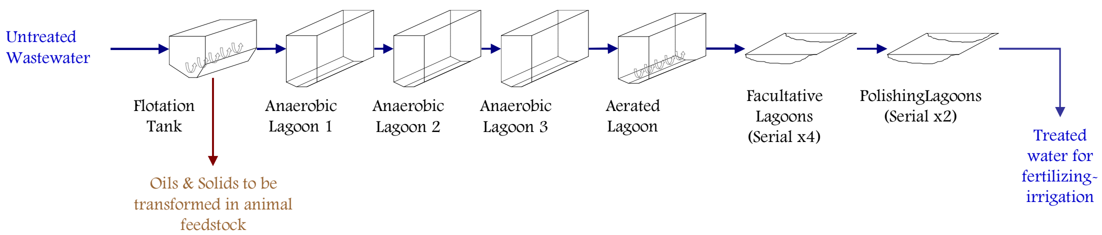


Fig. 10. Waste water treatment in the baseline scenario

Wastewater stream arrives to the treatment plant and a primary mechanical treatment (coarse screening) is carried out, where coarse solid matters are separated from water stream. After coarse screening, grease and oils in the water affluent, which are extremely damaging for water treatment process, are removed by a flotation system.

Wastewater without large solids or grease enters the first existing anaerobic lagoon, of 5 metres depth, to ensure the starting of the anaerobic degradation of water. In order to guarantee the complete anaerobic degradation of water, there are two anaerobic lagoons after the first one, where organic degradation finishes.

Anaerobically degraded wastewater enters an aerated lagoon where oxidation happens due to aeration systems. The remaining organic matter in water is oxidized in this aerated lagoon. The final discharge pathway in the baseline scenario is the first of the four serial facultative lagoons.

Sludge generated during the wastewater treatment is driven to facultative and polishing lagoons together with water treated. This water, which composition includes specific amounts of organic nutrients, is used for irrigation, profiting its fertilizing properties.

Regarding the emissions due to electricity consumption, in the absence of the project activity, the electricity requirements in Lar's facilities would be met through the connection and consumption of electricity from the grid since no electricity would be generated from biogas in the baseline scenario.

Project scenario

The project activity involves two implementation stages, as explained in section A.4.2.

The first stage consists of the modification of the three existing anaerobic open lagoons. Two of them will be covered with PVC geo-membranes to operate as anaerobic digesters with methane recovery systems. The third lagoon will be equipped with surface aerators and will operate as an aerated lagoon, hence degrading organic matter in wastewater without methane emissions. No uncontrolled methane emissions from anaerobic decomposition of wastewater will occur. The generated and recovered biogas during the anaerobic treatment will be combusted for power generation and/or flared.

In this first stage, methane emissions will be avoided in the following ways:

1. By covering two of the three anaerobic lagoons, methane emissions generated will be recovered instead of being released to the atmosphere.
2. By installing aerating equipment in the third existing anaerobic lagoon, water will be aerobically treated and no methane will be generated in this stage of the treatment.
3. By using the renewable biogas generated in anaerobic digestion as a source of energy for electricity generation, electricity consumption from the grid will be displaced. In the absence of the project activity (systems under AMS.I.D), the electricity requirements would be covered by consuming electricity from the grid.

The second stage, which is due to the increase in the production capacity of the Industrial Chicken Unit, will involve the increase of the wastewater production from the current 150m^3/h up to 350m^3/h.

With this second stage, the wastewater entering the plant will be treated as follows:

1. 80m^3/h out of the total water inflow will enter the anaerobic digesters.
2. This digested water will meet the remaining flow (270m^3/h) before entering the aerated treatment. Organic matter in water inflow will be efficiently reduced by new aerated treatments which consist of the following:
    a. A new flotation tank, with a treatment efficiency over 90%;
    b. An aeration treatment system step. The remaining anaerobic lagoon and the first facultative lagoon will be equipped with new aeration equipment and the existing aerated lagoon will be re-equipped.
3. Biogas generated during wastewater digestion will be recovered and combusted for power generation and/or flared. The electricity generated will displace electricity consumption from the grid. In the absence of the project activity, no engine would be installed and electricity required would be purchased from the grid.
4. Treated water will be discharged into a new decanter and used for irrigation or disinfected for reuse.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

According to Appendix B of the Simplified Modalities and Procedures for CDM Small Scale Project Activities, project participants are required to provide an explanation to show that the project activity would not have occurred in the absence of the CDM due to one of the following barriers:

(a) Investment barrier;
(b) Barrier due to prevailing practice;
(c) Other barriers;

This barrier analysis corresponds with the step 3 of the *"**Indicative simplified baseline and monitoring methodologies for selected small scale CDM Project activity categories**",* for capacity increase in project type II and type III *(EB 55, Annex 35, Paragraph 19).*

According to paragraph 7 of this guideline, the demonstration of additionality will also refer the additional guidances in the "*Non-binding best practice examples to demonstrate additionality for SSC project activities*" (EB35, Annex 34) and the "*Guidelines for objective demonstration and assessment of barriers*" version 01 (EB 50 Annex 13).

An explanation showing that the project activity would have not occurred in the absence of the CDM is provided below.

Identification of barriers to be faced for the implementation of the project activity

The proposed project activity consists on the reduction of the methane emissions from the current wastewater treatment at Industrial Chicken Unit in Lar with a less carbon intensive solution implemented in two stages:

1. Stage 1: current water inflow. reduction of methane emissions due to anaerobic treatment of wastewater: this will be achieved through the installation of a sequential phase of anaerobic digestion with methane recovery before the aerated lagoons (the existing aerated lagoon which is refurbished and the third existing anaerobic lagoon, which is transformed in an aerated lagoon).
    a. Two existing anaerobic lagoons will be refurbished and covered with geo-membranes. Biogas generated in the anaerobic treatment will be captured;
    b. The recovered biogas will be combusted as a source of energy for power generation in new specific engines and/or flared;
    c. The third existing anaerobic lagoon will be equipped with surface aerators and will operate as an aerated lagoon.

    Hence, in this first stage of implementation, no uncontrolled methane emissions will be released to the atmosphere.

2. Stage 2: the water inflow will increase progressively up to 350m^3/h. A 80m3/h flow will enter the bio-digesters and the remaining flow will be treated in the new physical-chemical flotation tank and the new aerated lagoons, a complete system consisting on the following:

a. New physical-chemical flotation tank;
b. Three aerated lagoons: the remaining anaerobic lagoon (existing third) will be re-equipped with new surface aerators. New aeration equipment will be installed in the existing aerated lagoon and in the first existing facultative lagoon, which will start to operate as an aerated lagoon in the aerated lagoons system. The second existing facultative lagoon will be the discharge point, operating as a secondary decanter.

In the absence of the proposed project activity, Cooperativa Lar would have decided to continue with a wastewater treatment which is well known and does not require a very high investment nor very specific operation and maintenance procedures. The company would have chosen to excavate new lagoons in order to increase the retention time in anaerobic lagoons and maintain the removal efficiency.

However and considering that this process is in accordance with Brazilian regulation regarding wastewater treatment, it will lead to methane emissions that will be released to the atmosphere. Moreover, with the expansion of the production capacity at the Industrial Chicken Unit and the foreseeable increase of anaerobic open lagoons, the amount of methane released to the atmosphere will also increase.

But the continuation of the current situation would require a smaller investment from the project developer, would lead to lower O&M costs and would not involve the installation, operation and maintenance of mechanical equipment, hence would not imply any technological risk.

According to Attachment A to Appendix B of the "Simplified Modalities and Procedures for Small Scale CDM project activities" and to Annex 34 from the 35th EB Meeting, "Non-binding best practice examples to demonstrate additionality for SSC project activities", project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier:

A financially more viable alternative to the project activity would have led to higher emissions

According to the Non-binding best practice examples to demonstrate additionality for SSC project activities", *best practice examples include but are not limited to, the application of investment comparison analysis using (...) or a simple cost analysis (where CDM is the only revenue stream such as end-use energy efficiency).*

In August, 2006[31], Cooperativa Lar, together with the following institutions, embarked this project with the aim of analyzing the possibility of generate small amounts of electricity from wastes coming from animal manure. The proposal was called "Desenvolvimento de Modelo de Geraçao Distribuída com Saneamento Ambiental" (Development of an Environmental Sutainable Generation Model).

[31] **Itaipú: Sustainability Report, 2006. Section: 1:51. Page : 54.** http://www.itaipu.gov.br/files/sustentabilidade_2006.pdf
Desenvolvimento de Modelo de Geraçao Distribuida com Saneamento Ambiental. Copel. 2006

The institutions participating in the development of the project activity are the following:

- Cooperativa Agroindustrial Lar (involved party);
- COPEL (Companhia Paranaense de Energia) (involved party);
- Fundaçao Parque Tecnologico Itaipú Brasil (involved party);
- Instituto Ambiental do Paraná (IAP) (involved party);
- Instituto de Tecnología Aplicada e Inovaáo (ITAI) (executive party);
- Instituto de Tecnología Aplicada e Inovaçao (proposing party); and
- Itaipú Binacional (involved party);

According to the proposal, the aim of the project activity is to encourage the development of procedures and methodologies which will contribute to their development and to check the technical, financial and environmental feasibility of such projects, which uses the waste biomass in wastewater from agro-industrial activities to produce electricity. The main target of the project is to develop the required tools to synchronize and make it feasible to safely generate energy and to develop monitoring and measurement mechanisms.

However, the main restrictions for developing this programme were the financing difficulties, more specifically, the following:

- Prices of the required equipment not in accordance with the budget available for the project;
- Not enough financial resources for the development of the programme.

As explained in section A.4.4, the project was presented to FINEP with the purpose of getting some financial aid. FINEP finally agreed to finance through the FNDCT[32] the equipment acquisition and other activities included in the "Methane recovery part" after analyzing the proposal about the development of the project and the possibility of receiving carbon credits.

As stated in FINEP's guidelines[33], the general objectives of these financing tools and policies are the following:

- To encourage and finance innovation and scientific and technological research, which might contribute to extend knowledge and/or generate positive impacts in Brazilian social and economic development, with a view to:
    - Extending and improving the National S,T&I system, encouraging the production of knowledge and the improvement of scientific and technological skills in the country;
    - Stimulating and supporting activities that encourage the expansion of innovation, generation and adaptation capacity in technological and scientific knowledge, for the production of goods and services;
    - Cooperating towards success of the targets established by the Federal Government's policies.

It is clear that because the proposed project is a pioneer project in Brazil and will contribute to sustainable development by reducing the GHG emissions, FINEP finally gave this financial aid.

[32] **Ministerio da Ciencia e Tecnologia**. *http://sigcti.mct.gov.br/fundos/rel/ctl/ctl.php?act=nav.prj_vis&idp=2922*
[33] **FINEP**. Areas of activity. Page 3. *http://www.finep.gov.br//english/folder_ingles.pdf*

But, despite the financial aid from FINEP, the project proponent is facing a very important investment to develop the proposed project activity.

Cooperativa Lar will finance from own resources, more than 80% of the total investment, which means more than 4 million reais[34].

From the financial point of view, the implementation of the project activity requires an extra investment for mechanical equipment installation, extra O&M costs foreseen because of the higher complexity of the project activity, the requirement of more staff responsible for the operation of the new proposed wastewater treatment, the requirement of training this staff in the operation of the new equipment and facilities and a significant deviation from the core business, that would have not happened if the proposed project would not have been implemented.

The proposed project activity implies the installation of new equipment which would not be required in case that Cooperativa Lar would have continued with the same treatment concept than before, a concept that would have led to higher GHG emissions.

In that case, Cooperativa Lar would have required the excavation of new lagoons in order to accomplish with the regulation regarding wastewater treatment and disposal in Brazil, which establishes a maximum concentration of organic load in wastewater discharge. In this regard, Cooperativa Lar considered, before deciding to go onwards with the proposed project activity, to open new anaerobic, facultative and maturation lagoons which would contribute to increase the retention time of wastewater and which effluent would have been in accordance with Brazilian regulation.

Equipment required

Existing open anaerobic lagoons need to be lined with geomembranes in order to be modified into biodigesters. The major investment needed for anaerobic lagoons closing is assumed by FINEP, but, as explained, under the proposal from Programa de Geraçao Distribuida, which considered the reduction of GHG emissions to the atmosphere and the possibility of apply for carbon credits under the CDM.

There are other mechanical equipments which have to be installed in the biodigesters which are not financed by FINEP. And, apart from this, the most important investment is allocated in the second stage of implementation of the project. Building the PCF Tank, installing the pumping stations, acquiring the aeration equipment, the scratching bridges, the collection and distribution tanks, etc, involve large investments that would not occur if Cooperativa Lar decided to treat the surplus flow in new anaerobic open lagoons[35].

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[34] 1 BRL = 0. 0.556784 USD. Rates at 23/09/2009. http://www.xe.com/ucc/convert.cgi

[35] **"Application of soluble enzymes to wastewater treatment with high lipid content"** (Aplicaçao de lipases no tratamento de aguas residuárias com elevados teores de lipídeos)**.** A. Aguiar Mendes, H. Ferreira de Castro, Departamento de Engenharia Química, Faculdade de Engenharia Química de Lorena, CP 116, 12606-970 Lorena – SP; E. Benedito Pereira e A. Furigo Jr, Departamento de Engenharia Química e Engenharia de Alimentos, Universidade Federal de Santa Catarina, CP 476. Quim. Nova, Vol. 28, No. 2, 296-305, 2005. ***"In the contrary of aerobic processes, those anaerobic do not require artificial aeration equipment. (...) The anaerobic process results in a low biomass production, around 10-20% of the production in the aerobic treatment, due to the low growing ratio of microorganisms in the anaerobic system****". (Ao contrário dos processos aeróbios, os processos anaeróbios não necessitam de equipamentos de aeração artificial. (...)O*

Moreover, maintenance costs associated to the wastewater treatment in anaerobic lagoons are lower since the solid formation in anaerobic treatment is much lower than in aerated treatments. Hence, maintenance is easier and less costly in anaerobic treatment than in aerated treatment.

Obviously, if the project proponent would have chosen to keep on treating wastewater in anaerobic open lagoons and facultative lagoons, the investment would not have been zero, but it would easily have been lower since the major expense would be allocated in the excavation of the new lagoons.

Apart from this, the project proponent, by implementing the proposed project activity, is subjected to power consumptions and O&M costs that in the absence of the project activity, would occur in a significant lower amount. Anaerobic open lagoons do not require any mechanical equipment for proper operation and maintenance is very easy, with similar removal efficiency than water treatments based on aerated lagoons[36].

Incentives to project promoter

The project promoter does not have any financial incentive to develop the proposed project activity but the potential benefits from the CDM. It could be considered that the generation of electricity from biogas was an incentive for the project participant since it would displace the electricity consumption from the grid. However, the installation of aeration and agitation equipment, the blowers, and all the mechanical equipment involved in the proposed project activity will increase the power consumption.

Then, without the potential benefits of the Clean Development Mechanism, the project proponent would not have had any financial incentive to get involved in the proposed project activity.

Investment analysis[37]

The aim of this investment analysis is the demonstration of the investment barrier.

In this case, the investment analysis has been done for demonstrating the investment barrier and, also, it matches with the application of step 3 of the ***Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories***, barrier analysis.

This investment analysis pretends to demonstrate that the only plausible baseline scenario is the scenario 2 discussed in section B.4. The project scenario, in the absence of the CDM, is demonstrated not to be economically attractive in the absence of the benefits from the CDM.

processo anaeróbio possui baixa produção de biomassa, apenas 10 a 20% do volume produzido no aeróbio, devido à reduzida taxa de crescimento dos microrganismos no consórcio anaeróbio). http://quimicanova.sbq.org.br/qn/qnol/2005/vol28n2/21-DV03325.pdf

[36] **"Sistematizaçao de informaçoes técnicas e económicas sobre alternativas de tratamento de esgotos"** Universidade de Sao Paulo. Núcleo de Pesquisa em Informaçoes Urbanas. *http://www.usp.br/fau/pesquisa/infurb/urbagua/mf1/mf1.pdf*

[37] All figures are referenced in the excel file "Invesment comparison analysis"

"*The purpose of an investment analysis in the context of the CDM is to determine whether the project is less financially attractive than at least one alternative in which the project participants could have invested*"[38]. "*The only means of determining that the project activity is less financially attractive than at least one alternative is to conduct an investment comparison analysis*". This is exactly what has been done below.

In the following tables it it shown the financials of the two options considered by Cooperativa Lar for the wastewater treatment after the inflow increase. The analysis is based on the investment comparison of the two options considered by Cooperativa Lar, which are the following:

1. The continuation with the current treatment "concept", with its expansion through the opening of new anaerobic, facultative and polishing lagoons with the aim of receiving the increased water flow and maintaining a similar retention time of wastewater. As it has been explained before, Cooperativa Lar has enough own space to open new lagoons in the nearby zone, making it feasible this option for the treatment of the increase in the wastewater flow;
2. The implementation of the proposed project activity;

The following considerations have been done for the investment analysis:

- O&M costs are not accurately estimated in the moment of the validation. Obviously, these O&M costs in the project situation will be higher than those in the case of opening new lagoons, where no engines, aeration equipment, biogas pipelines, etc, exist. Moreover, the operation of anaerobic and facultative lagoons, as explained in this PDD, does not require any mechanical equipment for aeration, agitation or other.
- The persons in charge of the wastewater treatment will require a specific training. The costs associated to this training have not been considered in the investment comparison analysis. Obviously, for the operation of a system with new anaerobic and facultative lagoons, it would not be necessary to specifically train the staff in the plant since they have been working on the operation of this type of plant for years.
- The hiring of new qualified staff will be necessary in the project situation. It is not clear nor evident that in the baseline situation, in which Cooperativa Lar would have opened new anaerobic, facultative lagoons, it would not be necessary. Thus, the hiring of new staff has not been considered in the financial analysis.
- The quotation from the main supplier has been considered in this investment analysis.
- Cooperativa Lar would save expenses from the reduction of electricity consumption due to the implementation of the project activity. However, the electricity requirements will increase due to the implementation of the proposed project activity.
- If the project activity would not have been implemented, Cooperativa Lar would not have recovered biogas from the anaerobic digestion and would have had no chance to generate electricity from this biogas. Hence, incomes from electricity generation would have not happened in the absence of the project activity.

[38] **"Combined tool to identify the baseline scenario and demonstrate additionality".** Version 02.2. http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf

- In order to consider in a conservative manner the incomes from electricity generation in the project activity, the following has been assumed (only for electricity generation calculation purposes):
  - The generation sets work at full rated capacity and 8760h/year;
  - The consuming equipment in the project activity operates 24 hours per day, seven days a week;
  - The electricity price is 0,12395 R$/kWh in non-peak hours and 0.77478 R$/kWh in the peak hours;
  - Peak tariff is applicable 3h/day. Non peak tariff is applicable 21 h/day[39];
  - Cooperativa Lar could export electricity to the grid. The tariff for electricity sold to the grid is considered in accordance with the purchase agreement between Cooperativa Lar and the electricity dealer;
  - The peak tariff for electricity purchased from the grid is the highest of the three considered tariffs. During the 3 hours per day of peak tariff, Cooperativa Lar will use the electricity generated in the biogas fed engines for self consumption. With this consideration, Coopeativa Lar will consider a reduction in the electricity consumption during the peak hours;
  - The non peak tariff for electricity purchased from the grid is lower than the price that the electricity dealer would pay for the electricity generated through biogas combustion in engines. Hence, during non-peak hours (21h/d) it will be considered in the investment analysis that Cooperativa Lar will sell all the electricity generated to the grid and will purchase the amount of energy required for project equipment operation.
  - FINEP has financed a part of the project activities;

According to this, the following comparison analysis shows how CDM is essential in the development of the proposed project activity, from the financial point of view.

[39] **Taxes and Tariffs. COPEL**. Peak hours: from 18h to 21 h (except in summer time) and from 19h to 22h (during the summer time)

http://www.copel.com/hpcopel/root/nivel2.jsp?endereco=%2Fhpcopel%2Facopel%2Fpagcopel2.nsf%2Fverdocatual%2F5BAFDCF77F92F5A5032573EC006C3074

Total investment resulting from the implementation of the proposed project activity:

Lar received a quotation for the implementation of each and every step of implementation of the proposed project activity. Apart from this, in the moment of redaction of this PDD, Cooperativa Lar had already made some payments and had several invoices at their disposal. Based on this quotation for the implementation of the second stage of the project activity (taking into account that, in the moment of the validation, the final supplier was not decided) and on the available invoices for the project activity, the PP has developed the following analyses:

Project Activity		
	Total Budget	
Total Investment Lar	4,135,993	R$
Financed by FINEP	903,000	R$
Total Investment	**5,038,993**	**R$**

Without the CDM, the proposed project activity would have not taken place. In 2006, Cooperativa Lar got involved in the Decentralized Power Generation Project with the commitment of developing an innovative and pioneer project in Brazil.

One of the incentives for Cooperativa Lar to get involved in this project was the potential generation of carbon credits, which could contribute to overcome the multiple barriers associated to the implementation. Without that contribution, Cooperativa Lar would have counted only with the economical support from FINEP, which is not attractive enough to develop the whole proposed project since it accounts for less than 19% of the whole investment.

On the other hand, in case that Cooperativa Lar would have decided to open the new anaerobic and facultative lagoons required to accomplish the Brazilian regulation in wastewater treatment and disposal, the investment required would have been the following[40]:

Lagoons Construction		
Anaerobic lagoons (x3)		
Facultative lagoons (x3)		
Maduration lagoons (x2)		
	6.50	R$/m3
	204,312.87	m3
Total investment from Lar	**1,328,033.66**	**R$**

Which is much less than the investment required in the proposed project activity.

[40] Figures are based on the quotation for the excavation of the anaerobic, facultative and polishing lagoons (named “lagoas de maturaçao” in the quotation supporting) required to maintain the minimum retention time to ensure that the organic load in the discharged water would be under the limits established by the national regulation.

It could be thought that considering the incomes from electricity generation, the economical feasibility of the project would be clear.

The project scenario considers the installation of three biogas generation sets, one with 100kVA and two with 50 kVA. The total installed capacity is 160kW of electricity which will be generated for self consumption.

The project scenario also considers the installation of aeration and agitation equipment which consumes electricity. The total installed capacity of this equipment is 137.445kW if a 10% of distribution losses is assumed.

It has been considered in the investment analysis that project equipment will operate 24 h/day.

The biogas engines are supposed to operate 8760h/day, which is conservative since in this figure, no maintenance periods are considered, nor eventual stops of the engines.

The installed capacity of equipment and the installed capacity for electricity generation in biogas engines are summarized in the following tables:

Equipment installed[41]

	Inst. Power (kW)
Agitation pumps	14.7
Aeration equipment in aerated lagoons	
Aerated lagoon 1	11.025
	14.7
Aerated lagoon 2	44.1
	14.7
Aerated lagoon 3	11.025
	14.7
Distribution losses (10%)	12.495
Total installed capacity	137.445

[41] Environmental Control Plan

The only incomes in the proposed project activity, come from electricity savings and export to the grid. In order to be as conservative as possible, the project participants have made a complete analysis of the possible incomes from this energy generation considering the following parameters and considerations:

1. Electricity price paid for power purchased from the grid. It has been considered the peak and the non-peak tariffs in the calculation;
2. Electricity price for power sold to the grid, according to the Purchase Agreement between Cooperativa Lar and the electricity dealer;
3. The following assumptions have been made:
    1. During peak hours, Lar will not export electricity to the grid;
        a. *Lar would save expenses due to the reduction of power consumption in peak hours.*
    2. During these peak hours, 100% of electricity generated by biogas gensets will be self consumed;
        a. *Lar will not export electricity to the grid during peak hours*
    3. During non-peak hours, 100% of the electricity generated by engines will be exported to the grid:
        a. *The sale price will be as per the Purchase Agreement between Lar and the dealer;*
    4. During non-peak hours, electricity consumed by the project equipment will be purchased from the grid
        a. *Purchase price during non peak hours is under the sale price for Decentralized Generation;*

An inflation rate for electricity prices has been considered according to the forecast of the Brazilian Government for regulated prices[42].

Year	Yearly savings
2010	165,480
2011	170,735
2012	176,185
2013	181,836
2014	187,697
2015	193,773
2016	200,073
2017	206,605
2018	213,377
2019	220,396
2020	227,673
Savings in 10 years	2,143,831

[42] The forecast inflation rate for electricity price in 2010 is 3.5%. This rate has been considered for the whole crediting period for the investment analysis. (http://www.agenciabrasil.gov.br/noticias/2009/11/23/materia.2009-11-23.7938623086/view)

The difference between the investment and the maximum incomes in the project situation is still higher than the total investment required for opening new lagoons[43].

Project Situation

Total Investment Required	5,038,993	R$
Financed by FINEP	903,000	R$
Total Investment Lar	4,135,993	R$
Max Incomes Power Generation (10 years)	2,143,831	R$
Net Investment Lar	**1,992,162**	R$

Baseline Situation

Total Investment Required	1,328,034	R$
Incomes Power Generation (10 years)	-	R$
Net Investment Lar	1,328,034	R$

The net investment required from Cooperativa Lar is much higher in the project situation than in the alternative scenario, also considering the maximum incomes received for the electricity generated by the combustion of biogas in the engines.

The additional incomes of carbon credits would clearly help the project proponent to overcome this financial risk. In 2006 there was not a transparent carbon market. However, different specialized companies made estimations on the CER prices. Based on these estimations, the company took the decision of develop the project activity since the potential sale of CER could help to overcome the significant investment required for the implementation of this project activity.

Carbon instrument	Price
EUAs Dec 06 (1st phase)	€12
EUAs Dec 08 (2nd phase)	€16
CERs (buyer takes on risk)	€2-8
CERs (seller takes on risk)	€7-11
CERs (issued)	€10-13
ERUs	€5-6

Table 9. Estimation of Carbon Credits' prices as per September 2006. Source: ECX,. EcoSeccurities, CCX. *http://www.carbonpositive.net/viewarticle.aspx?articleID=49*

As per the explanation above, it is clear that there is a significant financial barrier associated to the implementation of this project activity and which was faced due to the potential generation of carbon credits and the estimative prices of those in the moment of the decision.

[43] All figures and calculations are included in the excel file "Investment Comparison Analysis"

The CDM clearly alleviates the investment to be faced by Lar for the development of the proposed project activity. Transparent documentation substantiates this analysis, which, as it has been explained before, has been done based on a conservative approach. This is in accordance with the guideline 2 of the "*Guidelines for Objective Demonstration and Assessment of Barriers*", version 01 (EB50, Annex 13). In fact, there is a clear impact of the CDM in the alleviation of the investment barrier, which, in the absence of the project activity, would not have been faced by Cooperativa Lar. In that case, the Project Proponent would have decided not to risk such an amount of own funds and would have reduced their risk to the minimum required, which corresponds with the excavation and opening of new anaerobic, facultative and polishing lagoons and, this way, increase the treatment capacity and maintain the retention time required to remove enough COD.

(b) Barrier due to prevailing practice

Prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

The meat and poultry processing facilities typically employ anaerobic lagoons to treat their wastewater[44],[45]. In Brazil there is no regulation for methane recovery in anaerobic wastewater treatment or for turning the open anaerobic lagoon treatments into aerated systems in order to avoid methane emissions. This low-tech and low-cost technology is the most common in the agro-industrial sector in Brazil, also in the chicken industry[46],[47]. According to the National Methane Inventory for Waste Management in Brazil[48], the industrial effluents from different sectors, as food, beverages, chemistry, metal, textile, leather and paper, have been traditionally treated through lagoons or activated sludge systems or biological filters. In the earlier 80's, some anaerobic filters units existed and in the last years, there has been a strong increase in the use of anaerobic reactors for industrial effluent treatment. Sectors using this technology benefit from the operation of these systems, as the low space requirements and the absence of aeration energy.

According to the report titled "technical and environmental guidance on processing materials in slaughterhouses (bovine and swine)"[49] published by CETESB (Environmental Technology Company (Companhia de Tecnologia de Saneamento Ambental) in 2008, a typical wastewater treatment in the swine and bovine industrial sectors, which effluent is quite similar (in terms of organic loads and type) to the poultry industry, presents the following structure:

1. Primary treatment: for gross solid removal, mainly through physical forces.
2. Equalization /homogenization: to minimizing the settling of suspended solids through mixing processes;
3. Secondary treatment: for colloids removal through biological activation (…). In this stage, stabilization lagoons are distinguished, especially anaerobic lagoons (...).,

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[44] **"2006 IPCC Guidelines for National Greenhouse Gas Inventories".** Chapter 6. Wastewater Treatment and Discharge. Page 20.

[45] **Slaughterhouses: Bovine and Swine Industry,** Goverment of Sao Paulo. CETESB - Environmental Sanitation Technology Company & FIESP – Industries Federation of the State of Sao Paulo, 2008. *http://www.cetesb.sp.gov.br/Tecnologia/producao_limpa/documentos/frigorifico.pdf*

[46] **"Technical evaluation of a stabilization lagoons based system treating poultry effluents"** (Avaliaçao técnica de um sistema de lagoas de estabilizaçao tratando efluentes de frigorífico de frangos) *http://www.ufpel.edu.br/cic/2004/arquivos/conteudo_EN.html#01070*

[47] **Evaluation of operation in stabilization lagoons in wastewater treatment from slaughterhouse.** (Avaliacáo do desempenho de lagoas de estabilizaçao no tratamento de efluentes de matadouro). "***The stabilization lagoons are an extended method of waste treatment in industries which present, as a main characteristic, the high organic matter concentration****" (As lagoas de estabilização são um método difundido no tratamento de despejos domésticos ou industriais que apresentem, como característica, grande concentração de matéria orgânica)*. Carlos Nobuyoshi Ide. ABES - Associação Brasileira de Engenharia Sanitária e Ambiental.

[48] **National Methane Inventory for Waste Management in Brazil. Volume 1, July, 1998. "Enabling Brazil to Fulfill its Commitments to the UNFCCC)** Alves, J. Manso, S.M. CETESB, 1998. Page 25. http://homologa.ambiente.sp.gov.br/proclima/publicacoes/publicacoes_portugues/inventario_de_residuos_brasil.pdf

[49] **"technical and environmental guidance on processing materials in slaughterhouses (bovine and swine)"** (Graxarias Processamento de Materiais de Abatedouros e Frigorificos Bovinos e Suínos. CETESB 2008. http://www.cetesb.sp.gov.br/Tecnologia/producao_limpa/documentos/graxaria.pdf

In fact, in the country, anaerobic lagoons correspond to the baseline for CDM projects based on mitigation of greenhouse gases from animal wastes management systems[50]. The Ministry of the Environment in Brazil considers only two possible baseline scenarios for treatment of manure from livestock farming[51]:

3. "anaerobic lagoons" that are generally used in Brazil;
4. "anaerobic digesters", which are more advanced but rarely adopted;

Depending on different criteria and due to the effluent characteristics (high organic loads), the majority of slaughterhouses treating their effluents use biological processes as stabilization lagoons, anaerobic systems or activated sludge[52]. One of the criteria in the selection of the treatment is the availability of space. The less space is available, the more compact would the treatment system be.

Obviously, in the absence of the CDM, Cooperativa Lar would not have get involved in the development of the project activity and would not have built anaerobic digesters, but new anaerobic lagoons. Moreover, according to the same reference, "*substantial investment is needed for anaerobic digesters, and detailed monitoring and system maintenance need to be performed. On the other hand, anaerobic lagoons represent simple and inexpensive technology, with straightforward operation and maintenance. Anaerobic lagoons should be installed as the baseline scenario from the perspective of both investment and technological barriers".*

There are no available data about the fraction of wastewater anaerobically treated in Brazil. The exact knowledge of this fraction would imply the availability of information about the various systems used for industrial effluent treatment throughout the country, and it would be recommended that this information is surveyed and processed[53]. But, by the moment, this information is not available. However, many examples of slaughterhouses in Brazil were found with wastewater treatments based on stabilization lagoons[54], [55],[56].

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[50] "**Brazil Profile for Animal Waste Management"** Methane to Markets Agriculture Subcommittee, December, 2006 http://www.methanetomarkets.org/resources/ag/docs/brazil_profile.pdf

[51] **"Fiscal 2006 CDM/JI Project Research Swine Farms in the State of Santa Catarina, Brazil".** The Japan Research Institute. March, 2007. *http://gec.jp/gec/gec.nsf/3d2318747561e5f549256b470023347f/0af2af9a8f44acab4925730d002ebb86/$FILE/Summary_JapanResearch.pdf*

[52] **"The potential reuse of water (treated effluents) in slaughterhouses",** (O Potencial de Reuso de Água (Efluentes Tratados) em um Matadouro-Frigorífico), João Pedro de Mello Forlani , Mônica Medeiros, Prof. M.Sc. Luis Fernando Rossi Léo. UNILIN. I Simposium of Environmental Engineering. (Anais do I Simpósio da Engenharia Ambiental).Page 83 & 85. http://www.eesc.usp.br/sea/sea2004/arquivos/Anais_-_SEA-2004.pdf

[53] **"First Brazilian Inventory of Anthropogenic Greenhouse Gas Emissions".** Page 67/85**.** http://homologa.ambiente.sp.gov.br/biogas/docs/relatorios_referencias/tratamento_de_residuos/rr_90_94_ingles.pdf

[54] **"Effluent management in poultry slaughterhouses: case study (super frango)"** (Gerenciamento de efluentes de abatedouros avícolas estudo de caso (super frango))**.** J.Fernandes Jr, O Mendes. Universidade Católica de Goiás – Departamento de Engenharia – Engenharia Ambiental AV. Universitária, nº 1440, Setor Universitário, Goiânia. ***"Stabilization lagoons are considered as one of the simplest technologies for wastewater treatment"*** *(As lagoas de estabilização são consideradas como uma das técnicas mais simples de tratamento de esgotos).*

[55] **"Evaluation of the treatment efficiency in wastewater treatment systems in slaughterhouses with stabilization lagoons and post-treatment in cultivated bed"** (Avaliaçao da eficiencia de sistemas de tratamento de efluentes de

These stabilization lagoons present four types of configuration depending on their depth: aerobic, with around 0.5m depth, anaerobic, between 2 and 4.5m depth, facultative, with 1.5m depth and maturation lagoons, after the secondary treatments and with around 1 m depth[57]. Depending, above all, on the space availability, the poultry processing industries are limited in the election of one treatment or another, trying to reduce the operational costs with a reasonable treatment efficiency.

According to the Federal University of Mato Grosso[58], the processes largely developed in Brazil consist in up to two stages: preliminary and secondary, where:

- Preliminary: sieving for entrail removal, grease separation.
- Secondary: lagoons – use of a serial of **anaerobic, facultative and algae** lagoons.

In case that no space was available for the implementation of lagoons, the preliminary process would be completed with an equalization tank, a physical chemical flotation and a biologic treatment with activated sludge. However, the implementation of such treatment process would not happen if space was available to open new anaerobic lagoons, due to the higher operational and maintenance costs and the energy consumption associated to an aerated treatment.

If anaerobic lagoons are suitable to be the water treatment, this is, if there is space enough to open new anaerobic lagoons, the poultry processing industry would not consider any additional expenses and costs, nor any additional worries due to maintenance of equipment, lagoon cleaning, etc, related to the wastewater treatment. The only cost to be considered will be related to the excavation of new open lagoons which will allow to keep on treating wastewater as up to date.

This is actually Cooperativa Lar's situation. In fact, Cooperativa Lar has at its disposal enough space to open new lagoons to keep on treating wastewater as per current.

Apart from this, aerated systems require a high energy consumption and generate high amounts of sludge, higher than anaerobic systems. This is another reason why anaerobic tanks are very common in poultry processing industries in Brazil[59].

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matadouro tratados por lagoas de estabilizaçao e postratamento em banhados artificiais de leitos cultivados)**.** A.Garcia Arnal Barbedo, L.Marques Imolene, C.Nobuyoshi Ide, K.Francis Roche, J.Gonda.

[56] "*Ponds in which wastes are allowed to decompose over long periods of time and aeration is provided only by wind action. Sunlight is allowed to fall on sewage to purify it*". **Environmental Terminology and Discovery Service (ETDS), European Environmental Agency.** http://glossary.eea.europa.eu/terminology/concept_html?term=stabilisation%20lagoon

[57] **Consideration of the alternatives for minimization of impacts generated by slughterhouse effluents**. *(Levantamento das alternativas de minimização dos impactos gerados pelos efluentes de abatedouros e frigoríficos)*. Tânia Luisa Maldaner. Universidade castelo branco pró-reitoria de pesquisa e pós-graduação coordenação de pós-graduação curso de pós-graduação "lato sensu" em higiene e inspeção de produto de origem animal. http://www.qualittas.com.br/documentos/Levantamento%20das%20Alternativas%20de%20Minimizacao%20dos%20Impactos%20-%20Tania%20Luisa%20Maldaner.PDF

[58] **"Treatment and control of industrial effluents"**. Engo. Gandhi Giordano, D.Sc, Prof. Adjunto do Departamento de Engenharia Sanitária e do Meio Ambiente – UERJ Diretor Técnico da Tecma-Tecnologia em Meio Ambiente Ltda. *http://www.ufmt.br/esa/Modulo_II_Efluentes_Industriais/Apost_EI_2004_1ABES_Mato_Grosso_UFMT2.pdf*

[59] **"Perspectives for the water conservation and reuse in the food industry – Study in a poultry slughterhouse unit"** (Perspectivas para conservaçao e reuso de agua na industria de alimentos-Estudo de uma unidade de processamento de

Some references consider the anaerobic treatments for farming and agricultural wastes as the most interesting treatments in Brazil for wastewater and liquid waste treatment, increasing in the last years due to the significant advantages when compared with other treatment processes or composting process[60], [61], [62].

There are many examples of the use of this sort of treatment in chicken slaughterhouses and animal manure management industry in Brazil.

Moreover, wastewater treatment in open anaerobic lagoons is a widespread practice in the poultry processing industry due to the low operation and maintenance costs and the compliance with country regulations. In fact, COPEL (Companhia Paranaense de Energia) encouraged the programme of "Geraçao Distribuida" in 2006, together with Cooperativa Lar and the above mentioned companies and institutions, in order to make it feasible to generate electricity from biogas recovered from wastewater coming from animal manure and to develop monitoring and measurement systems, since methane recovery from anaerobic degradation is neither mandatory nor usual in wastewater treatment plants. In fact, up to 2008, no similar project activity (anaerobic to aerated treatment in wastewater treatment) was registered under CDM in Brazil under AMS.III.H. Only one project activity suitable to be eligible under AMS.III.H has been registered in Brazil in September 2009[63] up to date. Currently, three projects are under validation[64].

The first project of similar characteristics in Brazil, also encouraged by COPEL and Itaipú, was developed in a swine farm, in Sao Miguel do Iguaçú[65]. After that, other projects and prototypes have been developed by Itaipú-COPEL, including the programme which includes this Cooperativa Lar project activity.

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frangos). E.Myho Matsumura. Dissertaçao apresentada a Escola Politécnica da Universidade de Sao Paulo. Sao Paulo, 2007. Page 79. Reference: *http://www.teses.usp.br/teses/disponiveis/3/3147/tde-04072007-125053/*

[60] **"Paraná experience in wastewater treatment in small and medium scale"** (Experiência paranaense de tratamento de esgotos em pequena e média escala) Bollmann, Harry Alberto; Aisse, Miguel Mansur; Gomes, Celso Savelli.. Abstract. http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&src=google&base=REPIDISCA&lang=p&nextAction=lnk&exprSearch=102936&indexSearch=ID

[61] **"Evaluation of the anaerobic biodegrability of wastes in bovine and swine industry" (Avaliação da biodegradabilidade anaeróbia de resíduos da bovinocultura e da suinocultura).** LM. MoraesI; DR.Paula Jr. Eng. Agríc. vol.24 no.2 Botucatu May/Aug. 2004 ***"The interest for the anaerobic treatment of solid and liquid wastes from agriculture and agro-industry, has increased in the last years due to the significative advantages when compared with other common processes for wastewater aerobic treatment or the conventional composting of solid organic wastes treatment"*** *(O interesse pelo tratamento anaeróbio, de resíduos líquidos e sólidos provenientes da agropecuária e da agroindústria, tem aumentado nos últimos anos, por apresentar vantagens significativas quando comparado aos processos comumente utilizados de tratamento aeróbio de águas residuárias, ou aos processos convencionais de compostagem aeróbia de resíduos orgânicos sólidos).*

Reference: *http://www.scielo.br/scielo.php?pid=S0100-69162004000200025&script=sci_arttext*

[62] **"Systematization of technical and economical information about alternatives in wastewater treatment"** (Sistematizaçao de informaçoes técnicas e económicas sobre alternativas de tratamento de esgotos). Universidade de Sao Paulo. Núcleo de Pesquisa e Informaçoes Urbanas. Page 35. Table 2-7.

[63] **Project nº 2555 registered in September 2009.**

[64] **Projects at validation stage. UNFCCC.** *http://cdm.unfccc.int/Projects/Validation/index.html*

[65] **Rede de Tecnologia Social.** *http://www.rts.org.br/noticias/destaque-2/aneel-autoriza-geracao-de-energia-em-propriedades-rurais*

For this programme, Cooperativa Agroindustrial Lar collaborated with COPEL and with different entities which supported the research and analyzed the feasibility of such kind of projects. Hence, Cooperativa Agroindustrial Lar is one of the first companies in Brazil developing a project of such characteristics[66].

Apart from the fact that the wastewater treatment in the poultry industry in Brazil is mainly based on stabilization lagoons, the main trouble yet to be solved is the huge amount of water used in this production process. The first references to wastewater reuse in poultry industry in Brazil, are dated in 2007[67].

There are no references or paper analysing the minimization of effluent volume to be treated, but the analysis are focused on the treatment itself [67].

Cooperativa Lar, by implementing the proposed project activity, will not only reduce the amount of methane released to the atmosphere and use the biogas generated for power generation, but will contribute to reduce water consumption in the production process in a 70% and will reuse the rest of water treated for irrigation purposes.

This project is pioneer in Brazil, environmentally friendly and respectful and will contribute to reduce GHG emissions and water consumption in the region, to mitigate climate change, improve the conditions in the river ecosystem and reduce water requirements in the production process. This is not a prevailing nor a common practice in the poultry industry in Brazil.

Conclusion

The outcome of the third step of the analysis in paragraph 16 of the ***Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories*** is the list of barriers that may prevent one or more alternative scenarios to occur. These barriers, as explained above, are the investment and the prevailing practice barrier.

Cooperativa Lar is one of the first companies participating in this kind of projects, involving its own investment, taking risks and digressing from the core business, which is not the electricity generation or the biogas recovery, but the chicken industry. In fact, the programme was developed by different institutions in Brazil (ELETROBRAS, Itaipu Binacional, ELETROSUL, Companhia Paranaense de Energia – COPEL, Companhia de Saneamento do Paraná – SANEPAR) and Cooperativa Agroindustrial LAR, where the project is to be tested, in collaboration with R&D centres in the electricity field (CEPEL, LACTEC and Fundação PTI).

By getting involved in this project, risking their investment, digressing from the core business and modifying a functional wastewater treatment, Cooperativa Lar, with this project activity, will contribute to develop a realistic and replicable alternative to face the environmental costs of this sort of industries, which is decisive for the sustainability of the agro-industrial sector in Brazil.

[66] **Itaipú: Sustainability Report, 2006. Section: 1:52. Page : 55.** http://www.itaipu.gov.br/files/sustentabilidade_2006.pdf

[67] **"Perspectives for the water conservation and reuse in the food industry – Study in a poultry slughterhouse unit"** (Perspectivas para conservaçao e reuso de agua na industria de alimentos-Estudo de uma unidade de processamento de frangos). E.Myho Matsumura. Dissertaçao apresentada a Escola Politécnica da Universidade de Sao Paulo. Sao Paulo, 2007. Reference: *http://www.teses.usp.br/teses/disponiveis/3/3147/tde-04072007-125053/*

The aim of the programme, based on the sustainable development and the contribution to mitigate pollution and climate change due to GHG emissions in wastewater treatment in manure systems in Brazil, was to help and guide the national policies to define, identify and recognize the use of this “alternative source of energy” as a feasible and suitable resource for energy generation and contribute to its integration in the Interconnected National Grid (SIN) in Brazil, and to develop the mechanisms to ensure a feasible energy generation, monitoring and measurement systems.

The proposed project activity involves a complete change in the wastewater treatment in Cooperativa Lar’s chicken processing unit. This modification implies a significant net investment which has to be entirely assumed by Lar and which does not revert in significant revenues from electricity generation, as it has been explained above.

The decision making was based on the potential of the proposed project of generating carbon credits that could overcome the financial barrier faced in the project. The estimation of the possibility of recovering a part of the investment was based on the CER’s estimations by different companies, since there was not a transparent CER market.

Moreover, the conception of the wastewater treatment was completely new in Brazil and, hence, the project started its development under a R&D programme together with other entities involved. The environmental approach was clearly explained in the Project Document submitted to FINEP for financial aid application in 2006. And already in 2006, the entities involved in the proposal considered the eligibility of the proposed project under the Clean Development Mechanism, which would obviously help them to implement the project. Cooperativa Lar, looking for the environmental excellence, took the commitment of going further with the proposal. Taking into account the foreseen increase in the production and the increase in wastewater flow, Lar undertook to reduce to the maximum possible the methane emissions and maximize the reuse of treated water.

Cooperativa Lar considered the implications of such commitment. The possible incomes from electricity displacement from the grid, which are drastically reduced due to the higher power consumption resulting from the installation of the new equipment, were taken into account together with the possibility of getting carbon credits to be sold.

As per the above, there are no economical incentives for modifying the treatment concept with anaerobic open lagoons instead of maintaining the treatment concept by opening new lagoons to receive the increased flow and maintain the required retention time, moreover taking into account that there are no regulations that force the company to treat wastewater differently. And the development of wastewater treatment in the poultry industry in Brazil is not implementing these measures for methane recovery and reduction of biogas releases to the atmosphere. Some studies are starting to appear considering the importance of increase the water reuse in slaughterhouses but that is all.

Hence, it is clear that in the absence of the CDM additional revenues, the project owner would have no motivation from the financial point of view to risk their own funds, to digress from their business and to face such a project, completely new for Cooperativa Lar, nor to change the existing wastewater treatment concept at their unit for chicken. As explained in section B.4, in the absence of the project activity, the project proponent would have decided to construct (excavate) other open anaerobic and facultative lagoons with the only aim of maintaining an enough retention time to ensure that COD, SS and BOD_5 removal were proper and according the Brazilian regulation.

Those new lagoons would allow the project proponent to increase the volume available for anaerobic treatment in open lagoons, thus ensuring a minimum retention time in them.

Cooperativa Lar would not have got involved in such a kind of project unless there was not a commitment with mitigation of climate change and with the reduction of GHG emissions to the atmosphere. Hence, in the absence of the CDM, the proposed project activity would have not taken place.

In conclusion, it has been demonstrated that **the only alternative scenario that is not prevented by any barrier is the continuation with the current wastewater treatment based in anaerobic open lagoons and subsequent aerated, facultative and polishing lagoons and the expansion through the construction of new open anaerobic, facultative and polishing lagoons in the nearby zone in order to treat the increase of water inflow and maintain the minimum retention time required for removing the same COD amount than in the current situation.** In this unique possible baseline scenario, no electricity would be generated from renewable sources since no biogas would be recovered. Electricity required for the operation of the plant, would be purchased from the grid, as before. This alternative scenario is, in accordance with the *Indicative simplified baseline and monitoring methodologies,* version 14 (EB55, Annex 35).

Chronology of actions taken for the development of the proposed project under CDM

In August 2006, Cooperativa Lar developed together with the below mentioned entities a document regarding the "Programa de Geraçao Distribuida" (Decentralized Power Generation Programme) with the aim of applying for funds to FINEP to develop this Programme[68].

Entities Participating in "Programa de Geraçao Distribuida"

- Companhia Paraenense de Energia – COPEL
- Itaipu Binacional
- Companhia de Saneamento do Estado do Paraná – SANEPAR
- Cooperativa Agroindustrial Lar
- Instituto Ambiental do Paraná – IAP
- LACTEC

The mentioned document considers the following five pilot projects to be developed under "Programa de Geraçao Distribuida" and applies FINEP for funds to facilitate the development of these pilot projects in Brazil.

- Industrial Wastewater Treatment Plant at Cooperativa Lar Slaughterhouse, Matelândia, Paraná;
- Manure Management System at Unidade Produtora de Leitoes, UPL, Itaipulandia, Paraná;
- Bundled Treatment System at 33 Pig Farms at rio Toledo Region, Paraná;
- Manure Management System at Cooperativa Lar, Itaipulandia, Paraná;
- Urban Wastewater Treatment System by Sanepar, Foz do Iguazú, Paraná;

In page 19 of this document it is specifically mentioned the possibility of obtaining Carbon Credits by developing these projects under the Clean Development Mechanism.

"It has to be mentioned the possibility of this programme to be eligible under Clean Development Mechanism (CDM) and, this way, receive additional carbon credits due to the methane emissions reduction to the atmosphere, being methane a constituent of biogas and with a greenhouse gas effect twenty one times larger than carbon dioxide".

This document, signed by all the participant entities, was submitted to FINEP for funding application, at the end of 2006.

FINEP emitted an acknowledgment ("Recibo Eletronico") on 11/12/2006[69]. From this moment, FINEP undertook to evaluate the application in order to approve or reject the financial aid.

[68] "Programa de Geraçao Distribuida" elaborated by Cooperativa Lar and the other participating entities, has been submitted to the auditor during the site visit.

[69] **The "Recibo Eletronico" (Electronic Recipe)** signed by FINEP acknowledging the reception of the mentioned document, was submitted to the auditor during the site visit.

In the meanwhile, Cooperativa Lar, in order to develop their wastewater treatment project in the Slaughterhouse under the CDM, asked a CDM Consultancy Company for a proposal of consultancy services. This company sent a proposal[70] to Cooperativa Lar in March, 2007.

Since the approval from FINEP was not received, Cooperativa Lar did not start the development of the wastewater project.

In March, 2008, Cooperativa Lar got in contact with Zeroemissions do Brasil. The communications[71] were focused on the probable development of this project activity, still subject to FINEP approval for financial aid.

During the following weeks, Cooperativa Lar and Zeroemissions do Brasil negotiated the proposal and in March, 2008, Zeroemissions do Brasil sent a formal proposal to Cooperativa Lar for the development of the proposed project activity under CDM and including the modification of the anaerobic treatment system by an aeration lagoons treatment system and a treated water reuse.

Before accepting the proposal from Zeroemissions do Brasil, Cooperativa Lar waited to receive the definitive approval from FINEP for financial aid[72]. This approval was received on 15/05/2008. On this date, the contract between FINEP and Instituto de Tecnologia Aplicada e Innovaçao – ITAI, was signed to partially finance the "Programa de Geraçao Distribuida com Saneamento Ambiental" (Contractual Code: 0/1/08/0159/00)

On 20/06/2008, a month after receiving the confirmation from FINEP for the financial aid, Cooperativa Lar started with a significant expense related to the cleaning process of the first anaerobic existing lagoon, lagoon nº1, to be covered and converted into a biodigester.

On August, 2008, Cooperativa Lar sent a Letter of Intention[73] to Zeroemissions do Brasil for the development of the proposed project activity under the CDM. This LoI derived in the signature of an Emission Reduction Purchase Agreement (ERPA) between Cooperativa Lar and Zeroemissions do Brasil on 25/09/2008.

Zeroemissions do Brasil together with its mother company Zero Emissions Technologies SA, started to develop the proposed project under the CDM.

In October 2008, Zeroemissions do Brasil started to contact different DOEs for the validation of Cooperativa Lar Project.
On December, 2008, Zero Emissions Technologies SA started to negotiate an agreement with TUEV SUED for the validation of several project activities. A pipeline with projects proposed to be validated in which the Cooperativa Lar project activity was included, was sent to TUEV SUED.

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[70] **Proposal** for the development of the Cooperativa Lar Wastewater Project shown to the auditor during the Site Visit.

[71] **Communication evidences** between Cooperativa Lar and Zeroemissions do Brasil in March and April 2008 were submitted to the auditor during the site visit.

[72] **Approval from FINEP** regarding the Programa de Geraçao Distribuida and a copy of the contract between FINEP and ITAIPU for the financial aid for the development of Cooperativa Lar project, was submitted to the auditor during the site visit.

[73] **A copy of this LoI** was submitted to the auditor during the site visit.

In March, 2009, the contract between Tuv Sud and Zero Emissions Technologies SA was signed. In the meanwhile, Zeroemissions do Brasil and Zero Emissions Technologies SA were in permanent contact with Cooperativa Lar for the redaction of the PDD and the collection of the information regarding the proposed project.

On 29/04/2009, Zero Emissions Technologies SA sent a work order for the validation process of Cooperativa Lar project to Tuv Sud.

The PDD was finally uploaded at UNFCCC on 15/05/2009.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Determination of baseline COD values

The chemical oxygen demand is one of the critical parameters to be determined in the baseline in order to calculate baseline emissions associated to the project activity. Cooperativa Lar has periodically measured the organic loads in wastewater from 2007 and has also cross checked their measures with an external laboratory. Both, Cooperativa Lar and the external laboratory, have measured the organic loads in wastewater by means of the "standard methods for the examination of water and wastewater, 20º edition".

In order to have a reliable value for COD, the project proponent has considered every available measure from January 2007 until November 2008. The COD considered was measured in different sites of the wastewater treatment. The relevant sites considered for COD measurement are:

- Outlet from the flotation tank;
- Outlet from the first anaerobic lagoon;
- Outlet from the second anaerobic lagoon;
- Outlet from the existing aerated lagoon;
- Outlet from the first facultative lagoon;

In order to have a more reliable and confident value of COD, the maximum and minimum values measured in the relevant period, where refused from the average COD calculation. The outletCOD values finally considered are shown in the table below.

Outlet COD						
	Flotation Tank	Anaerobic Lagoon 1	Anaerobic Lagoon 2	Anaerobic Lagoon 3	Aerated Lagoon 1	Facultative Lagoon 1
Average	3,223	1,538	1,227	1,016	673	379
Max	*7379*	*2427*	*1790*	*1798*	*1225*	*571*
Min	*1133*	*952*	*885*	*724*	*124*	*174*

Values Max and Min are removed from the initial data in order to have a more accurate value of inlet COD in each system. The following are the final data used in the calculation of Emission Reductions

	Flotation Tank	Anaerobic Lagoon 1	Anaerobic Lagoon 2	Anaerobic Lagoon 3	Aerated Lagoon 1	Facultative Lagoon 1
Average	3,132	1,540	1,264	1,047	691	397
Removed		1,592	276	217	356	294
Efficiency	20%	51%	18%	17%	34%	43%
	(Environmenta l Control Plan)	Calculated	Calculated	Calculated	Calculated	Calculated

Table 10. Chemical Oxygen Demand values and removal efficiency calculated from the wastewater analyses in the period from Jan, 1st, 2007 until November, 2008.

Determination of emissions reduction

Emissions reduction is calculated according to the following formula:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

BE_y Baseline emissions in tCO_2/year in the year y;

PE_y Project emissions in tCO_2/year in the year y;

LE_y Leakages in tCO_2/year in the year y;

ER_y Emissions reduction in tCO_2/year in the year y;

According to this, baseline emissions, project emissions and leakages will be calculated as per the applicable methodologies.

AMS. III.H. Methane emissions from baseline wastewater treatment systems

Baseline emissions according to AMS III.H are related to the methane emissions from the current wastewater treatment systems which will be equipped with methane recovery systems in the project scenario. In the three existing anaerobic open lagoons, bacteria degrade organic matter in wastewater into gases, mainly methane and carbonic gas.

According to the Small Scale CDM Simplified Baseline and Monitoring Methodology AMS.III.H, baseline emissions for the systems affected by the project activity may consist of the following:

$$\mathbf{BE_y = (BE_{y,\,power} + BE_{ww,y,\,treatment} + BE_{s,y,treatment} + BE_{ww,discharge,y} + BE_{s,\,final,y})}$$

***BE_y**: Baseline emissions in year y (tCO_2 eq);*

***$BE_{y,\,power}$** : Baseline emissions from electricity or fuel consumption in year y (tCO_2 eq);*

***$BE_{ww,y,\,treatment}$** : Baseline emissions of the wastewater treatment systems affected by the project activity in the year y (tCO_2 eq);*

***$BE_{s,y,treatment}$** : Baseline emissions of the sludge treatment systems affected by the project activity in the year y (tCO_2 eq);*

***$BE_{ww,discharge,y}$** : Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2 eq). The value of this term is zero in the case of introduction of anaerobic sludge treatment system with biogas recovery and combustion to an existing wastewater treatment plant without sludge treatment.*

***$BE_{s,\,final,y}$** : Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2 eq). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.*

*Baseline emissions from electricity consumption (**$BE_{power,y}$**) are determined as per the procedures described in AMS-I.D. The energy consumption shall include all equipment/devices in the baseline wastewater and sludge treatment facility. For emissions from fossil fuel consumption the emission factor for the fossil fuel shall be used (tCO_2/tonne). Local values are to be used, if local values are difficult to obtain, IPCC default values may be used. If recovered biogas in the baseline is used to power auxiliary equipment it should be taken into account accordingly, using zero as its emission factor.*

$BE_{ww,y,treatment}$: baseline emissions of the wastewater treatment systems affected by the project activity in the year y (tCO_{2e})

These emissions are determined using the methane generation potential of the treatment systems.

$$BE_{ww,y,treatment} = \sum Q_{ww,i,y} * COD_{removed,i,y} * MCF_{ww,treatment,BL,i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$$

$Q_{ww,i,y}$	Volume of the wastewater treated in baseline wastewater treatment system *i* in year *y* (m^3);
$COD_{removed,i,y}$	Chemical oxygen demand removed by baseline treatment system *i* in year y ($tonnes/m^3$) measured as the difference between inflow COD and the outflow COD in system *i*;
$MCF_{ww,treatment,BL,i}$	Methane correction factor for baseline wastewater treatment system i in year y;
i	Index for baseline wastewater treatment system;
$B_{o,ww}$	Methane producing capacity of the wastewater;
UF_{BL}	Model correction factor to account for model uncertainties (0.94);
GWP_{CH4}	Global Warming Potential for methane (value of 21);

If the baseline treatment system is different from the treatment system in the project scenario, the monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions ex post. The outflow COD of the baseline system will be estimated using the removal efficiency of the baseline treatment systems. The removal efficiency of the baseline systems will be measured ex ante through representative measurement campaign, or using historical records of COD removal efficiency of at least one year prior to the project implementation.

As explained above, the COD values in the baseline and the removal efficiency of each baseline equipment, have been estimated by considering the historical records of COD measurements at Cooperativa Lar wastewater treatment with data from 18 months prior to the project starting date and 5 months after project starting date, thus 23 months in total.

The Methane Correction Factor (MCF) shall be determined based on the following table:

Type of wastewater treatment and discharge pathway or system	MCF Value
Discharge of wastewater to sea, river or lake	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 metres)	0.2
Anaerobic deep lagoon (depth more than 2 metres)	0.8
Septic system	0.5

Table 11. IPCC default values for Methane Correction Factor (MCF)

Since the baseline treatment to which AMS III.H is applicable, consists of anaerobic open lagoons deeper than 2 m, the MCF is the one corresponding to an anaerobic deep lagoon (depth more than 2 meters), hence MCF=0.8.

$BE_{treatment,s,y}$: baseline emissions of the sludge treatment systems by the project activity in the year y (tCO_{2e})

In the baseline scenario, sludge generated in the wastewater treatment is not separated from treated water and arrives in the polishing lagoons. Sludge mixed in treated water gives it a nutrient component which makes it suitable for fertilizing irrigation.

Hence**, there is no sludge treatment (not even composting) in the baseline scenario** and thus baseline emissions due to sludge treatment systems are equal to zero.

$BE_{ww,discharge,y}$: methane emissions from degradable organic carbon in treated wastewater discharged in e.g. a river, sea or lake in the baseline situation in the year y (tCO_{2e})

$$BE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH_4} * B_{o,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,BL,discharge}$$

$Q_{ww,y}$	Volume of treated wastewater discharged in the year y (m^3)
UF_{BL}	Model correction factor to account for model uncertainties (0.94)
$COD_{ww,discharge,BL,y}$	Chemical oxygen demand of the treated water discharged into the sea, river or lake in the baseline situation in the year y (tonnes/m^3). If the baseline scenario is the discharge of untreated wastewater, the COD of untreated wastewater shall be used.
$MCF_{ww,discharge}$	Methane correction factor based on the discharge pathway in the baseline situation of the wastewater

The value of COD of water discharged has been estimated by means of data will be measured. The water flow will also be measured. Since discharge happens in open facultative lagoons deeper than 2 meters, the MCF for discharge is MCF=0.8.

$BE_{s,final,y}$: methane emissions from anaerobic decay of the final sludge produced in the year y (tCO_{2e})

In the baseline scenario, sludge generated in the wastewater treatment arrives in the polishing lagoon and is used together with treated water for fertilizing irrigation. **There is no sludge treatment in the baseline scenario and the use of sludge together with treated water for fertilizing irrigation does not lead to GHG emissions since there is no anaerobic decomposition of sludge. Hence these emissions are equal to zero in the baseline**.

$BE_{power,y}$: Baseline emissions from electricity consumption are determined as per the procedures described in **AMS.I.D.**

According to this, the baseline is the energy produced by the renewable generating unit (MWh) multiplied by an emission factor (tCO_{2e}/MWh) calculated in a transparent and conservative manner as follows:

- A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the Emission Factor for an electricity system';

OR

- The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.;

Calculations must be based on data from an official source (where available) and made publicly available.

For this project activity, the option a is selected. According to the applicable tool, the calculation of the operating margin emission factor (EFgrid,OM,y) is based on one of the following methods:

- Simple OM,
- Simple adjusted OM,
- Dispatch data analysis OM, or
- Average OM.

The project proponent will use the "Dispatch analysis method" for OM calculation. According to the applicable tool (Tool to calculate the emission factor for an electricity system, version 02), for this analysis, the year in which the project activity displaces grid electricity has to be used and the emission factor should be annually updated during monitoring.

The Ministry of Science and Technology in Brazil publishes every year the emission factor applicable to the Interconnected National Grid. On May, 18th, 2009, the EF was updated according to the "Tool to calculate the emission factor for an electricity system", version 02.

Data regarding the dispatch data analysis in Brazil are available at Ministério da Ciência & Tecnologia da Brasil web site (Ministry of Science and Technology, Brazil)[74].

Average monthly operating margin in 2007 is, as per Ministerio da Ciencia & Tecnología, as follows:

Jan	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dec	**Average**
0.2292	0.1954	0.1948	0.1965	0.1606	0.2559	0.3096	0.3240	0.355	0.3774	0.4059	0.4865	**0.2909**

The Build Margin emission factor corresponding to 2007 is EF_{BM} **=0.0775** tCO_2/MWh

[74] **Ministerio da Ciencia & Tecnologia da Brasil**: http://www.mct.gov.br/index.php/content/view/303073.html

The weight factors ω_{OM} and ω_{BM} (where $\omega_{OM} + \omega_{OM}$ = 1), and by default, are weighted equally (ω_{OM} = ω_{BM} = 0.5).

$$EF_{OM} = 0.2909 tCO_2 / MWh$$

$$\omega_{OM} = 0.5$$

$$EF_{BM} = 0.0775 tCO_2 / MWh$$

$$\omega_{BM} = 0.5$$

$$EF_{OM} = 0.5 * 0.2909 + 0.5 * 0.0775$$

Baseline emission factor will be (EF) = **0.1842** tCO_2/MWh

The grid emission factor was calculated by the Brazilian DNA (available at: http://www.mct.gov.br/index.php/content/view/307492.html) using the Dispatch Data Analysis for the Operating Margin. The Build Margin emission factor was determined using the generation-weighted average emission factor of all power units during the most recent year for which power generation data was available. Therefore, the emission factor of 0.1842 tCO2/MWh was accepted just for estimating the expected emission reductions of the project activity during the crediting period. Hence, the emission factor calculation used in this PDD, for estimating purposes only, must be verified and updated accordingly using the most recent data available at the time of the verification process.

Baseline emissions due to power consumption are calculated as follows:

$$BE_{power,y} = EG_{BL,y} * EF_{grid}$$

Where:

$BE_{power,y}$	Baseline emissions from electricity consumption in the year y;
$EG_{BL,y}$	Power generated from biogas recovered in the year y;
EF_{grid}	Emission factor for electricity;

AMS. III.I. Methane emissions from baseline wastewater treatment systems

Baseline methane emissions are related to the current wastewater treatment systems. In anaerobic open lagoons, bacteria degrade organic matter in wastewater into gases, mainly methane and carbonic gas. According to the Small Scale CDM Simplified Baseline and Monitoring Methodology AMS.III.I, baseline emissions for the systems affected by the project activity may consist of the following:

$$\mathbf{BE_y = (BE_{ww,y,\,treatment} + BE_{s,y,treatment} + BE_{ww,discharge,y} + BE_{s,\,final,y})}$$

BE_y: Baseline emissions in year y (tCO_2 eq);

$BE_{ww,y,\ treatment}$: Methane produced in the anaerobic baseline wastewater treatment system that is being replaced with the biological aerated system (tCO_2 eq);

$BE_{s,y,treatment}$: Methane produced in the baseline sludge treatment system (tCO_2eq);

$BE_{ww,discharge,y}$: Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into the river, sea or lake.

$BE_{s,\ final,y}$: Baseline methane emissions from anaerobic decay of the final sludge produced (tCO_2 eq).

$BE_{ww,y,treatment}$: baseline emissions of the wastewater treatment systems affected by the project activity in the year y (tCO_{2e})

These emissions are determined using the methane generation potential of the treatment systems.

$$BE_{ww,y,treatment} = \sum (Q_{ww,m,y} * COD_{removed,i,y} * MCF_{anaerobic,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4}$$

$Q_{ww,m,y}$	Volume of the wastewater treated during the months m, during year y, for the months with ambient average temperature above 15ºC (m^3);
$COD_{removed,i,y}$	Chemical oxygen demand removed by anaerobic wastewater treatment system I in the baseline situation in the year y for the months m with an ambient average temperature above 15ºC;
$MCF_{anaerobic,i}$	Methane correction factor for the anaerobic baseline wastewater treatment system i replaced by the project activity, value as per table III.I;
i	Index for baseline wastewater treatment system;
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC default value of 0.21 $kgCH_4/kgCOD$);
UF_{BL}	Model correction factor to account for model uncertainties (0.94);
GWP_{CH4}	Global Warming Potential for methane (value of 21);

To determine $COD_{removed,i,m,y}$, as the baseline treatment system is different from the treatment system in the project scenario, the monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions ex post. The COD removed by the baseline systems shall be based on the removal efficiency of the baseline systems.

Water flow and COD inflow and outflow will be measured in each anaerobic treatment replaced in the project scenario by an aerated system.

The Methane Correction Factor (MCF) shall be determined based on the following table:

Type of wastewater treatment and discharge pathway or system	**MCF Value**
Discharge of wastewater to sea, river or lake	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 metres)	0.2
Anaerobic deep lagoon (depth more than 2 metres)	0.8
Septic system	0.5

Table 12. IPCC default values for Methane Correction Factor (MCF)

The treatment systems modified in the project scenario are both anaerobic open lagoons with depth over 2 m and an aerated lagoon poorly managed. The applicable MCF is 0.8 for anaerobic lagoons and 0.3 for aerated lagoons poorly managed, according to the methodology.

$BE_{treatment,s,y}$: baseline emissions of the sludge treatment systems by the project activity in the year y (tCO_{2e})

These emissions are determined using the methane generation potential of the sludge treatment systems:

In the baseline situation, there is no sludge treatment. Treated water is used, from the polishing lagoons, together with the organic matter in it, for fertilizing irrigation.

In case sludge is composted, the following formula shall be applied:

$$BE_{treatment,s,y} = \sum S_{j,BL,y} * EF_{composting} * GWP_{CH4}$$

where:

Sludge in the baseline nor in the project activity is composted. These emissions are not considered.

$BE_{ww,discharge,y}$: methane emissions from degradable organic carbon in treated wastewater discharged in e.g. a river, sea or lake in the baseline situation in the year y (tCO_{2e})

$$BE_{tww,discharge,y} = Q_{ww,y} * GWP_{CH_4} * B_{o,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,BL,discharge}$$

$Q_{ww,y}$	Volume of treated wastewater discharged in the year y (m^3)
UF_{BL}	Model correction factor to account for model uncertainties (0.94)
$COD_{ww,discharge,BL,y}$	Chemical oxygen demand of the treated water discharged into the sea, river or lake in the baseline situation in the year y (tonnes/m^3).
$MCF_{ww,BL,discharge}$	Methane correction factor based on the discharge pathway in the baseline situation of the wastewater

The Methane Correction Factor (MCF) shall be determined based on the following table:

Type of wastewater treatment and discharge pathway or system	**MCF Value**
Discharge of wastewater to sea, river or lake	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 metres)	0.2
Anaerobic deep lagoon (depth more than 2 metres)	0.8
Septic system	0.5

Table 13. IPCC default values for Methane Correction Factor (MCF)

In the baseline situation, the systems affected by the project activyt under AMS.III.I discharge their wastewater in the facultative lagoon in both the first and the second stage of implementation. The MCF for these discharge pathways is 0.8 in both cases.

$BE_{s,final,y}$: methane emissions from anaerobic decay of the final sludge produced in the baseline situation in the year y (tCO_{2e})

Since sludge treatment is not modified due to the implementation of the project activity, these emissions are not considered in the baseline.

Project emissions

AMS.III.H.

Project activity emissions from the systems affected by the project activity are:

(i) CO_2 emissions on account of power and fuel use by the project activity facilities.

a. Electricity may be consumed by the biogas recovery equipment. Emissions due to this power consumption will be considered in the emission reduction calculation.

$$PE_{power,y} = E_{consumed,y} * EF_{grid}$$

i. In accordance to AMS.III.H (paragraph 26), "these emissions shall be calculated as per paragraph 19, for the situation of the project scenario".
ii. Paragraph 19 of the applicable methodology states that "emissions from electricity consumption are determined as per the procedures described in AMS-I.D"

(ii) Methane emissions from wastewater treatment systems affected by the project activity and not equipped with biogas recovery in the project situation.

$$PE_{ww,y,treatment} = \sum Q_{ww,i,y} * COD_{removed,i,y} * MCF_{ww,treatment,PJ,i} * B_{o,ww} * UF_{PJ} * GWP_{CH4}$$

$Q_{ww,i,y}$	Volume of the wastewater treated in the project scenario in the wastewater treatment system *i* in year *y* (m^3);
$COD_{removed,i,y}$	Chemical oxygen demand removed by project treatment system *i* in year y (tonnes/m^3) measured as the difference between inflow COD and the outflow COD in system *i*;
$MCF_{ww,treatment,BL,i}$	Methane correction factor for project wastewater treatment system i in year y;
i	Index for project wastewater treatment system;
$B_{o,ww}$	Methane producing capacity of the wastewater;
UF_{PJ}	Model correction factor to account for model uncertainties (1.06);
GWP_{CH4}	Global Warming Potential for methane (value of 21);

(iii) Methane emissions from sludge treatment systems affected by the project activity and not equipped with biogas recovery in the project situation.

a. Since sludge treatments are not affected by the proposed project activity, baseline and project emissions from sludge treatment are equal and, hence, not considered in the calculations.

(iv) Methane emissions on account of inefficiency of the project activity wastewater treatment system and presence of degradable organic carbon in treated wastewater.

$$PE_{tww,discharge,y} = Q_{ww,y} * GWP_{CH_4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge}$$

Where:

$Q_{ww,y}$	Volume of treated wastewater discharged in the year y (m^3)
UF_{BL}	Model correction factor to account for model uncertainties (1.06)
$COD_{ww,discharge,BL,y}$	Chemical oxygen demand of the treated water discharged into the sea, river or lake in the project situation in the year y (tonnes/m^3).
$MCF_{ww,discharge}$	Methane correction factor based on the discharge pathway in the project situation of the wastewater

(v) Methane emissions from the decay of the final sludge generated by the project activity treatment systems.

a. Since the decay of final sludge is not affected by the implementation of the proposed project activity, emissions due to this factor are not considered.

(vi) Methane fugitive emissions on account of inefficiencies in capture systems.

a. The only systems with biogas recovery in the project scenario are the bio-digesters.

$$PE_{fugitive,y} = (1 - CFE_{ww}) * MEP_{y,ww,treatment} * GWP_{CH_4};$$
$$MEP_{y,ww,treatment} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,untreated} * UF$$

Where:

CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems. (A default value of 0.9 shall be used)
$MEP_{ww,treatment,y}$	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in the year y;
$COD_{removed,PJ,k,y}$	Chemical oxygen demand removed by the treatment system k of the project activity equipped with biogas recovery in the year y (tonnes/m^3).
$MCF_{ww,treatment,PJ,k}$	Methane correction factor for the project wastewater treatment system k equipped with biogas recovery equipment (MCF values as per table III.H.1)
UF_{PJ}	Model correction factor to account for model uncertainties (1.06)

(vii) Methane emissions due to incomplete flaring.

a. As per the applicable methodologies, methane emissions due to incomplete flaring in year y as per the "tool to determine project emissions from flaring gases containing methane". The biogas produced in the project scenario will be combusted in the biogas engines for electricity generation. Excess biogas generated in the project activity will be flared in open flare.
b. Project emissions from flaring are not considered since the Project Promoter has decided not to account for emissions due to biogas flared in the open flare.

(viii) Methane emissions from biomass stored under anaerobic conditions which does not take place in the baseline situation.

a. There is no storage of biomass in the proposed project activity. Hence, these emissions are not accounted.

(ix) Project emissions related to the upgrading and compression of biogas:

a. The proposed project activity does not involve the upgrade and compression of biogas. Hence, these emissions are not considered.

AMS.III.I.

Project activity emissions consist of:

(i) CO_2 emissions related to the power and fossil fuel used by the project activity facilities.

b. Electricity may be consumed by the aeration equipment. Emissions due to this power consumption will be considered in the emission reduction calculation.

$$PE_{power,y} = E_{consumed,y} * EF_{grid}$$

i. In accordance to paragraph 14 of the methodology AMS.III.I, "project activity emissions from electricity and fossil fuel consumption ($PE_{power,y}$) are determined as per the procedures described in AMS-I.D".

(ii) Methane emissions during the treatment of the wastewater in biological aerated wastewater treatment systems.

$$PE_{ww,y,treatment} = \sum (Q_{ww,k,y} * COD_{removed,k,y} * MCF_{aerobic,k}) * B_{o,ww} * UF_{PJ} * GWP_{CH4}$$

$Q_{ww,i,y}$	Volume of the wastewater treated during the year *y* (m^3);
$COD_{removed,k,y}$	Chemical oxygen demand removed by the aerated system *k* in year y (tonnes/m^3)
$MCF_{aerobic,i}$	Methane correction factor for the aerated wastewater treatment system k (as per table III.I.1)
k	Index for project wastewater treatment system;
UF_{PJ}	Model correction factor to account for model uncertainties (1.06);

(iii) Methane emissions from degradable organic carbon in treated wastewater discharged in sea/river or lake.

$$PE_{ww,y,treatment} = Q_{ww,y} * GWP_{CH_4} * B_0 * UF_{PJ} * COD_{ww,discharge,y} * MCF_{ww,discharge}$$

Where:

$Q_{ww,i,y}$	Volume of the wastewater treated during the year y (m^3);
$COD_{ww,discharge,y}$	Chemical oxygen demand of the final treated wastewater discharged into sea, river or lake in the year y ($tonnes/m^3$)
$MCF_{ww,discharge}$	Methane correction factor based on the discharge pathway of the wastewater (as per table III.I.1)
UF_{PJ}	Model correction factor to account for model uncertainties (1.06);

(iv) Methane emissions from sludge treatment in the project activity.

a. Since the project activity does not involve the modification of the sludge treatment from the baseline, these project emissions are not considered.

(v) Methane emissions from the decay of final sludge generated by the project activity, if sludge is disposed to decay Anaerobically in a landfill without methane recovery.

a. Since the project activity does not involve the modification of the sludge treatment from the baseline, these project emissions are not considered.

AMS.I.D.

Project emissions due to power generation from the biogas recovered in the project scenario have been considered according to AMS III.H and AMS III.I. According to AMS I.D project emissions are equal to zero.

Leakages

AMS III.H.

If the technology is used, equipment transferred from another activity, leakage effects at the site of the other activity are to be considered.

There is no transfer of equipment from the site to another activity. Hence, leakage effects according to AMS.III.H are not to be considered.

AMS III.I.

If the aerobic treatment technology is equipped transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered.

The installed equipment in the aeration systems is not transferred from any other activity. Neither is there any transfer of equipment from the site to another activity. Hence, leakage effects according to AMS.III.I are not to be considered.

AMS.I.D

If the energy generating equipment is transferred from another activity, leakage is to be considered.

Energy generated equipment to be installed in the project site is not transferred from another activity. Hence, according to AMS.I.D, leakages are not to be considered.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$Q_{y,ww,i}$
Data unit:	m^3
Description:	Volume of wastewater treated in the baseline wastewater treatment i in year y (m^3). This value is equal to the volume of treated wastewater discharged in the baseline situation in year y.
Source of data used:	Measured by the Project Owner;
Value applied:	993,600;
Justification of the choice of data or description of measurement methods and procedures actually applied :	The average water inflow is $150m^3/h$ in the baseline. Considering 276 days/year of operation, the volume of wastewater treated in the baseline year has been calculated.
Any comment:	-

Data / Parameter:	$COD_{y,ww,removed,i}$
Data unit:	$tonnes/m^3$
Description:	Chemical Oxygen Demand removed by the baseline treatment system i in the year y;
Source of data used:	Calculated as $[COD_{y,ww,i,untreated} - COD_{y,ww,i,treated}]$ COD values have been analysed by Cooperativa Lar and cross checked with an external laboratory periodically.
Value applied:	Values applied for each system are indicated in section B.6.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated from COD inflow and outflow in the baseline treatment plant. Inflow and outflow COD in the systems affected by the project activity have been calculated from COD sample data taken by Cooperativa Lar and cross checked by a third party laboratory, from January 2007 until November 2008, i.e. 18 months prior and 5 months after the starting date of the project activity. Average data are shown in section B.6.1.
QA/QC procedures to be applied:	COD values used for estimation of baseline COD in the inflow and the outflow were periodically taken from January 2007 until November 2008, i.e. 18 months prior and 5 months after the starting date of the project activity. Hence, historical records of more than one year prior to the project implementation have been used.
Any comment:	.

Data / Parameter:	$COD_{y,ww,i,inflow}$
Data unit:	tonnes/m^3
Description:	Inflow Chemical Oxygen Demand in the baseline treatment system i in the year y;
Source of data used:	Project proponent – COD Data Sheet (Planilha de acompanhamento)
Value applied:	Values applied for each treatment system are indicated in section B.6.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Inflow COD has been calculated from COD samples data taken by Cooperativa Lar and cross checked by a third party laboratory, from January 2007 until November 2008, i.e. 18 months prior and 5 months after the starting date of the project activity. The Standard Method for the Examination of Water and Wastewater (American Public Health Association) was used for the analysis. Average data are shown in section B.6.1.
QA/QC procedures to be applied:	COD values used for estimation of baseline COD in the inflow were periodically taken from January 2007 until November 2008, i.e. 18 months prior and 5 months after the starting date of the project activity. Hence, historical records of more than one year prior to the project implementation have been used.
Any comment:	-

Data / Parameter:	$COD_{y,ww,I,outflow}$
Data unit:	tonnes/m^3
Description:	Outflow Chemical Oxygen Demand in the baseline treatment system i in the year y;
Source of data used:	Project proponent - “Planilha de acompanhamento”;
Value applied:	Values applied for each treatment system are indicated in section B.6.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Inflow COD has been calculated from COD samples data taken by Cooperativa Lar and cross checked by a third party laboratory, from January 2007 until November 2008, i.e. 18 months prior and 5 months after the starting date of the project activity. The Standard Method for the Examination of Water and Wastewater (American Public Health Association) was used for the analysis. Average data are shown in section B.6.1.
QA/QC procedures to be applied:	COD values used for estimation of baseline COD in the outflow were periodically taken from January 2007 until November 2008, i.e. 18 months prior and 5 months after the starting date of the project activity. Hence, historical records of more than one year prior to the project implementation have been used.
Any comment:	-

Note: the COD inflow measured for one system is equal to COD outflow of the immediately previous system when installed serial.

Data / Parameter:	$COD_{oremoval\ efficiency}$
Data unit:	%
Description:	Calculated
Source of data used:	$COD_{y,ww,i,inflow}$, $COD_{y,ww,i,outflow}$,
Value applied:	Data regarding removal efficiency for each treatment system are summarized in section B.6.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according to the following formula: $COD_{removal\_eff} = \left(\frac{COD_{y,ww,i,\inf low} - COD_{y,ww,i,outflow}}{COD_{y,ww,i,\inf low}} \right)$
QA/QC procedures to be applied:	COD values used for estimation of baseline COD in the outflow were periodically taken from January 2007 until November 2008, i.e.18 months prior and 5 months after the starting date of the project activity. Hence, historical records of more than one year prior to the project implementation have been used.
Any comment:	According to AMS.III.H, the outflow COD of the baseline system will be estimated using the removal efficiency of the baseline treatment systems. Since the historical records at disposal of the project proponent are referred to inflow and outflow COD, the removal efficiency has been estimated according to these data.

Data / Parameter:	CFE
Data unit:	Dimensionless
Description:	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data used:	AMS III.H
Value applied:	0.90
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value as per applicable methodology AMS III.H.
Any comment:	-

Data / Parameter:	$MCF_{ww,treatment,BL,i}$
Data unit:	-
Description:	Methane correction factor for baseline wastewater treatment systems i
Source of data used:	AMS III.H as per table III.H.1
Value applied:	0.8 in anaerobic open lagoons turned into aerated lagoons
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Values for MCF. In the baseline situation, the wastewater would have been treated in anaerobic lagoons with depth over 2m. According to the applicable methodology, $MCF_{ww,treatment,BL,i}$ is equal to 0.8 (AMS III.H table III.H.1)
Any comment:	-

Data / Parameter:	$B_{o,ww}$
Data unit:	Kg CH_4/kg COD
Description:	Methane generation capacity of the wastewater
Source of data used:	2006 IPCC Guidelines for Nacional Greenhouse Gas Inventories
Value applied:	0.21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value as per the applicable methodology
Any comment:	-

Data / Parameter:	UF_{BL}
Data unit:	-
Description:	Model correction factor to account for model uncertainties.
Source of data used:	AMS III.H & AMS.III.I
Value applied:	0.94
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value as per the applicable methodology.
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	Dimensionless
Description:	Global Warming Potential for methane
Source of data used:	IPCC 2006 Guidelines
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006
Any comment:	

Data / Parameter:	$COD_{y,ww,discharge,BL}$
Data unit:	tonnes/m^3
Description:	Chemical Oxygen Demand of the treated wastewater discharge into the sea, river or lake in the baseline situation in the year y;
Source of data used:	Measured by the project owner
Value applied:	Systems affected by the AMS.III.H: ➢ Discharge pathway in the baseline: third existing anaerobic lagoon ➢ COD discharge value: 0.001264 Systems affected by AMS.III.I: ➢ Discharge pathway in the baseline: ➢ *Stage 1: first existing facultative lagoon.* ➢ *COD discharge value: 0.000691* ➢ *Stage 2: second existing facultative lagoon* ➢ *COD discharge value: 0.000397*
Justification of the choice of data or description of measurement methods and procedures actually applied :	Discharge occurs in two places in each stage of implementation of the project, according to the applicability of the methodologies to each system affected by the project activity.
QA/QC procedures to be applied:	Historical data from January 2007 until November 2008, i.e., 18 months prior and 5 months after the starting date of the project activity have been used to calculate the average COD in the discharge points. Data regarding these COD values are summarized in section B.6.1.
Any comment:	-

Note: COD discharge is equal to COD outflow of the last treatment system included in the project boundary. I.e, COD outflow (new aerated lagoon) = COD discharge (as per AMS.III.I) in stage 1.

Data / Parameter:	$MCF_{ww,BL,discharge,y}$
Data unit:	-
Description:	Methane correction factor based on discharge pathway in the baseline situation (e.g. into sea, river or lake) of the wastewater
Source of data used:	AMS III.H as per Table III.H.1
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	Discharge from systems affected by the project in which AMS.III.H is applicable, discharge on the third existing anaerobic lagoon in the baseline.
Any comment:	-

Data / Parameter:	$MCF_{ww,BL,discharge,y}$
Data unit:	-
Description:	Methane correction factor based on discharge pathway in the baseline situation (e.g. into sea, river or lake) of the wastewater
Source of data used:	AMS III.I as per Table III.I.1
Value applied:	0.8 in stage 1 (discharge from aerated treatment occurs on the existing facultative lagoon nº1)[75]. 0.8 in stage 2 (discharge from aerated treatment system occurs in the second existing facultative lagoon, which is anaerobic)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Discharge from systems affected by the project in which AMS.III.I is applicable, discharge on the existing facultative lagoon nº2 in the second stage (would be the existing facultative lagoon nº 1 in the first stage).
Any comment:	-

Data / Parameter:	$MCF_{ww,treatment, PJ,k}$
Data unit:	-
Description:	Methane correction factor project wastewater treatment system k. (MCF values as per table III.H.1.)
Source of data used:	AMS.III.H
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values for MCF. AMS III.H table III.H.1 0.0 in aerated lagoons (aerobic treatment, well managed. In both stages 1&2) 0.0 in stage 2 in the PCF tank (aerobic treatment, well managed)
Any comment:	-

Data / Parameter:	UF_{PJ}
Data unit:	-
Description:	Model correction factor to account for model uncertainties in the project situation.
Source of data used:	AMS III.H & AMS.III.I
Value applied:	1.06
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value as per the applicable methodology.
Any comment:	-

[75] Note: The MCF corresponding to the discharge in the first stage of implementation has been included in the list of data available at validation. However, since the project activity is expected to be registered after the implementation of the second stage, this value will not be used for the calculation or the estimation of emission reductions.

Data / Parameter:	MCF $_{ww,PJ,discharge}$
Data unit:	-
Description:	Methane correction factor based on the discharge pathway in the project situation.
Source of data used:	AMS III.H & AMS.III.I
Value applied:	Equipment affected by AMS.III.H. ➢ Discharge pathway in project situation: PCF tank. Aerated well managed and existing aerated (former poorly managed). ➢ MCF = 0 Equipment affected by AMS.III.I. ➢ Discharge pathway in project situation: facultative lagoons with depth over 2m and secondary decanter ➢ MCF = 0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values for MCF as per AMS III.H table III.H.1 IPCC Default Values for MCF as per AMS.III.I table III.I.1.
Any comment:	Both methodologies AMS III.H and AMS.III.I consider the MCF in the discharge. Since the discharge pathway is different in systems affected by AMS.III.H and AMS.III.I, the values for MCF in the discharge are different.

Data / Parameter:	MCF $_{anaerobic,i}$
Data unit:	-
Description:	Methane correction factor for the anaerobic baseline wastewater treatment system i replaced by the project activity;
Source of data used:	AMS II.I as per table III.I.1;
Value applied:	Values applied depend on the system replaced: ➢ Anaerobic deep lagoon (depth>2 meters): 0.8; ➢ Aerobic treatment poorly managed or overloaded: 0.3;
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Values for MCF. AMS III.I table III.I.1
Any comment:	In stage 1, the third existing anaerobic lagoon is replaced by an aerated lagoon (anaerobic deep lagoon in the baseline situation; MCF=0.8). The aerated existing lagoon (poorly managed) is reequipped for a proper operation (aerobic treatment poorly managed in the baseline scenario; MCF=0.3). In stage 2, also the first facultative lagoon is replaced by an aerated lagoon well managed. These lagoons are deeper than 2m, hence, as per AMS.III.I are considered “deep lagoons”; MCF = 0.8

Data / Parameter:	$MCF_{aerobic,k}$
Data unit:	-
Description:	Methane correction factor for the aerobic wastewater treatment system k (MCF value for well managed aerobic biological systems, or for poorly managed or overloaded systems as per table III.I.1 shall be taken
Source of data used:	AMS.III.I
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values for MCF. AMS III.I table III.I.1 The aerated systems operating in the project activity are well managed systems. Value according to AMS.III.I, table III.I.1
Any comment:	-

Data / Parameter:	D_{ch4}
Data unit:	t/Nm^3
Description:	Density of methane
Source of data used:	ACM 0001
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value at standard conditions
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

Considerations as per the applicable methodologies

1. AMS.III.H.

According to paragraph 20 of AMS.III.H, "*if the baseline treatment system is different from the treatment system in the project scenario, the monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions ex post. The outflow COD of the baseline system will be estimated using the removal efficiency of the baseline treatment systems. The removal efficiency of the baseline systems will be measured ex ante through representative measurement campaign, or using historical records of COD removal efficiency of at least one year prior to the project implementation as per paragraph 17 or 18*".

According to paragraph 30 of the SSC methodology,
"*Ex post emission reductions shall be based on the lowest value of the following*:
(i) *The amount of biogas recovered and fuelled or flared (MD_y) during the crediting period, that is monitored ex post;*
(ii) Ex post calculated baseline, project and leakage emissions based on actual monitored data for the project activity."

As it has been explained, the PP will not apply for ER from the flaring of biogas in the safety torch, assuming that no biogas is flared. Hence, the paragraph above will refer only to biogas recovered and fuelled in biogas engines during the crediting period.

2. AMS.III.I.

"*To determine $COD_{removed,i,m,y}$: as the baseline treatment system(s) is different from the treatment system(s) in the project scenario, the monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions ex post*".

Baseline emissions

Explanation of the emission calculations considered in this PDD

In the moment of the validation, the project activity was being implemented as per the schedule shown in this PDD.

It is expected that the project will get the registered status on November, 1st , 2010. By this date, the second stage of implementation will be fully operational.

This **second stage** covers four sub-stages according to the wastewater inflow expected to be treated: Stage 2-I, Stage 2-II, Stage 2-III and Stage 2-IV.

The second stage starting date is scheduled on October 2010. However, the starting date of the crediting period is expected to be November, 1st, 2010. Hence, just for calculation purposes, the first sub-stage in the second stage of implementation (Stage 2-I) has been divided in two, according to the expected starting date of the crediting period**. There is no operational difference between Stage 2-Ia and Stage 2-Ib.** The sole purpose of this split is to clearly consider the exact date considered for the starting date of the crediting period.

Hence, emissions reductions calculation related to the first stage of the implementation have been excluded from this PDD, although the explanation of the systems affected by the project activity is extensive to both stages of implementation.

Thus, calculations have been done considering that the starting date of the crediting period will be 01/11/2010 and the following duration of each period of implementation:

Stage of implementation	Period	Duration (after 01/06/2010)
Stage I	June-Sept 2010	4 months
Stage 2 - Ia	October 2010	1 month
Expected starting date of the crediting period: November 2010		
Stage 2 - Ib	November-December 2010	2 months
Stage 2 - II	Jan-Mar 2011	3 months
Stage 2 - III	April-June 2011	6 months
Stage 2 - IV	July-Dec 2011 onwards	6 months – 1 year period

In case that the date of the implementation of each mentioned stage was modified and periods would change, this will be reflected in the monitoring report and baseline estimations will be adjusted according to the actual implementation process and each period.

Baseline emissions and project emissions calculations for the second stage of implementation will be shown in the PDD in a one-year period basis and considering the maximum wastewater flow in stage 2. Adjustments for each period according to the table above are included in the calculation sheet and reflected in the summary table for emission reductions.

Stage 2 of implementation:

In this stage of implementation, the digesters will treat a lower water flow than in the first implementation stage, only 80m^3/h. With this configuration, digestion efficiency will be improved.

The wastewater inflow, however, will be progressively increased due to a higher production capacity, up to 350m^3/h. At the end, the remaining 270m^3/h of inlet wastewater, which in the absence of the project activity would have been treated in anaerobic open lagoons without methane recovery systems, will be treated, in the project situation, in an physical-chemical aeration tank and in aerated lagoons.

For this purpose, the following modifications will be done:

- A new physical-chemical flotation tank will be built for inlet 360m^3/h water stream.
- This water stream will be the sum of the 80m3/h from the digestion process and another 270m3/h inflow wastewater, met in the homogenization tank. The surplus 10m^3/h come from the re-circulated sludge from the end of the treatment, which are injected directly in the PCF tank.
- The aerated lagoon which was refurbished during stage 1 of the project will keep on operating the same and the aeration equipment will be slightly modified as mentioned in section A.4.2.
- The first existing facultative lagoon will be refurbished as aerated lagoon.
- The three aerated lagoons will operate serial.
- The second existing facultative lagoon will be equipped with a scratching bridge to operate as secondary decanter.

The evolution of wastewater inflow during this stage of implementation is the following:

Stage of Implementation	Q inlet (m3/h)	Q inlet (m3/year)	Starting Date of Stage
Stage 2-I	223	1,473,840	Oct-Dec 2010
Stage 2-II	256	1,697,400	Jan-Mar 2011
Stage 2-III	329	2,177,640	April-June 2011
Stage 2-IV	350	2,318,400	July-Dec 2011

Table 1. Evolution of inlet wastewater during stage 2 of implementation. Source: Project Owner.

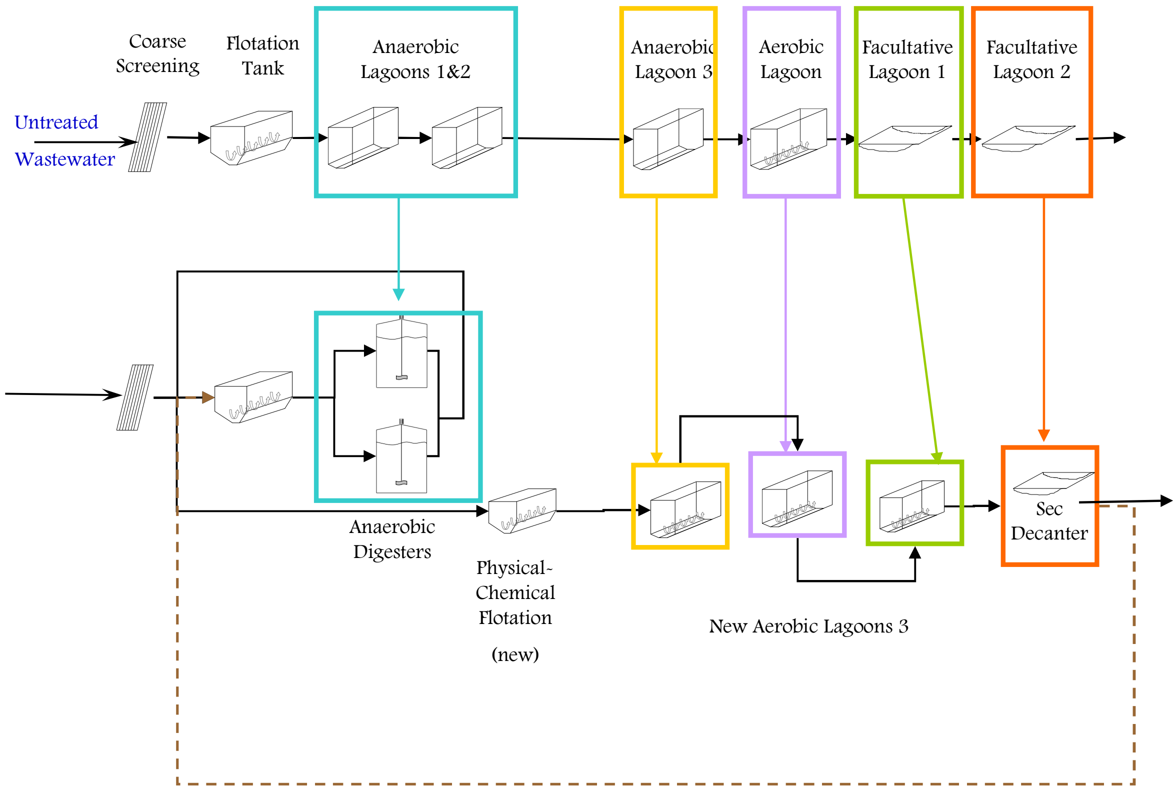


Fig. 11. Modifications from the baseline in the second stage of implementation. Source: Project Proponent.

Baseline Emissions: Second Stage of Implementation

As explained above, calculations have been done according to the expected starting date of the crediting period on November, 1^{st}, 2010. However, in the PDD, the figures for this second stage of implementation will refer to the maximum wastewater flow treated and in a one-year basis period. Detailed calculation is shown in the calculation sheet.

Emission reductions will be monitored according to the actual schedule of implementation in every verification period.

As per AMS.I.D:

Baseline emissions in the second stage of implementation are calculated based on the power that will be displaced from the grid due to biogas based generation engines. This power generated is:

$$EG_y = 0{,}16MW * 360d / year * 24h / d;$$
$$EG_y = 1{,}382tCO_2 / year$$

Hence, baseline emissions due to electricity generation by biogas engines are:

$$BE_{y,power} = EG_y * EF_{grid};$$
$$BE_{y,power} = 1{,}382MWh / year * 0.1842tCO_2 / MWh;$$
$$BE_{y,power} = 255tCO_2 / year$$

The baseline emissions will be adjusted in the monitoring report according to the duration of each period and the installed capacity of biogas engines. In the PDD and in the calculation sheet, baseline emissions, project emissions and emission reductions have been estimated considering the expected starting date of the crediting period on November, 1st, 2010.

Baseline emissions according to AMS.III-H and AMS.III.I are estimated based on the COD removed in each system affected by the project activity. The main COD figures (estimative) are shown in the graph below.

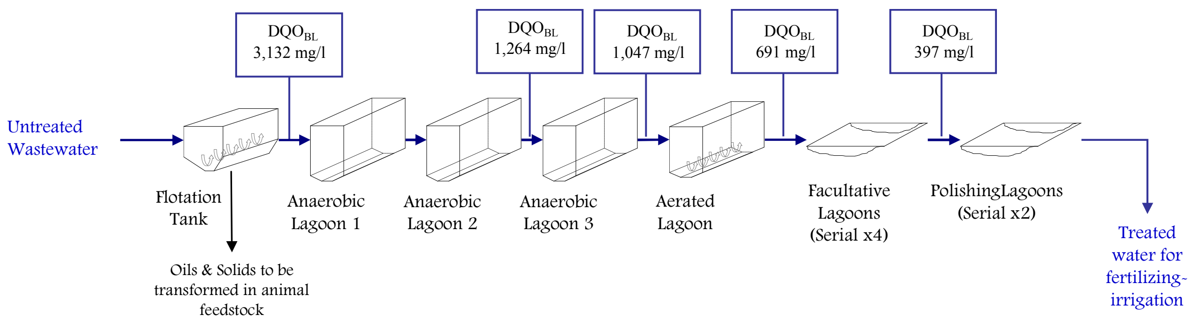


Fig. 12. COD values in the baseline situation. Systems affected by the project activity. Source: Project Owner.

As per AMS.III.H:

The wastewater flow affected by AMS.III.H is limited to 80m^3/h, which is 529,920 m^3/year.

$$BE_y = BE_{y,ww} + BE_{discharge,y};$$

1. $BE_{ww,y} = Q_{y,ww} * COD_{removed,i,y} * B_{o,ww} * MCF_{ww,treatment,BL,i} * UF_{BL} * GWP_{CH_4};$

The systems affected by the project activity are two of the three existing anaerobic open lagoons which are being covered and equipped with biogas recovery systems.

COD removed in both lagoons in the baseline situation is COD $_{removed}$ = 3,132-1,264 = 1868mg/l;

$$BE_{ww,y} = 529{,}920m^3 / year * 1.868e^{-3} tCOD / m^3 * 0.21 tCH_4 / tCOD * 0.8 * 0{,}94 * 21 tCO_2 / tCH_4;$$
$$BE_{ww,y} = 3{,}283 tCO_2 / year;$$

2. $BE_{discharge,y} = Q_{y,ww} * COD_{y,ww,discharge,BL} * UF_{BL} * B_{o,ww} * MCF_{ww,discharge}, BL * GWP_{CH_4};$

In the absence of the project activity, discharge from the anaerobic open lagoons would be done on the third anaerobic lagoon, with a depth over 2 meters. COD of discharged water in this lagoon is 1,264mg/l.

$$BE_{discharge,y} = 529{,}920m^3 / year * 1{,}264e^{-3} tCOD / m^3 * 0.94 * 0.21 tCH_4 / tCOD * 0.8 * 21 tCO_2 / tCH_4;$$
$$BE_{discharge,y} = 2{,}222 tCO_2 / year;$$

Total baseline emissions (as per AMS.III-H):

$$BE_y = 3{,}283 + 2{,}222;$$
$$BE_y = 5{,}504 tCO_{2eq} / year$$

As per AMS.III.I:

(Calculations are shown for the maximum inlet flow)

In the baseline situation, wastewater not passing through the biodigesters, would have been treated in the three existing anaerobic open lagoons, in an aerated lagoon poorly managed and in facultative anaerobic lagoons.

Instead of this, the wastewater will be treated in a new aeration system which includes a micro bubble physical chemical flotation tank, three aerated serial lagoons and a secondary decanter. Baseline emissions are calculated

The baseline emissions calculation for each system is calculated according to AMS.III.I.

$$BE_y = BE_{y,ww} + BE_{discharge,y};$$

1. $BE_{ww,y} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * UF_{BL} * MCF_{ww,treatment} * GWP_{CH_4};$

Anaerobic open lagoons:

- COD removed = 3,132-1,047 = 2,085mg/l
- MCF = 0.8

$$BE_{ww,y} = (2{,}318{,}400 - 529{,}920)m^3/year * 2{,}085e^{-3}tCOD/m^3 * 0.21tCH_4/tCOD * 0.94 * 0.8 * 21tCO_2/tCH_4;$$
$$BE_{ww,y} = 12{,}368tCO_2/year;$$

Aerated lagoon poorly managed modified to operate as an aerated lagoon well managed:

- COD removed = 1,047-691 = 356mg/l
- MCF = 0.3

$$BE_{ww,y} = (2{,}318{,}400 - 529{,}920)m^3/year * 356e^{-3}tCOD/m^3 * 0.21tCH_4/tCOD * 0.94 * 0.3 * 21tCO_2/tCH_4;$$
$$BE_{ww,y} = 791tCO_2/year;$$

Facultative lagoon (depth > 2m) modified into an aerated lagoon well managed:

- COD removed = 691-397 = 294mg/l
- MCF = 0.8

$$BE_{ww,y} = (2{,}318{,}400 - 529{,}920)m^3/year * 294e^{-3}tCOD/m^3 * 0.21tCH_4/tCOD * 0.94 * 0.8 * 21tCO_2/tCH_4;$$
$$BE_{ww,y} = 1{,}742tCO_2/year;$$

2. $BE_{discharge,y} = Q_{y,ww} * COD_{y,ww,discharge,BL} * UF_{BL} * B_o * MCF_{ww,discharge,BL} * GWP_{CH_4};$

Wastewater treated in the systems affected by the project activity would, in the baseline situation be discharged to the second existing facultative lagoon, which is similar to an anaerobic lagoon with depth over 2m. .

$$BE_{discharge,y} = (2{,}318{,}400 - 529{,}920)m^3 / year * 0.397e^{-3} tCOD / m^3 * 0.94 * 0.21 tCH_4 / tCOD * 0.8 * 21 tCO_2 / tCH_4;$$
$$BE_{discharge,y} = 2{,}356 tCO_2 / year;$$

The following table summarizes the baseline emissions for the second stage of implementation, considering the maximum water flow.

	Baseline Emissions
III.H	5,504
I.D	255
III.I	17,258
Total	23,017

Project emissions in the second stage of implementation of the project activity

In the following figure it has been represented the estimated COD in each relevant measure point in stage 2.

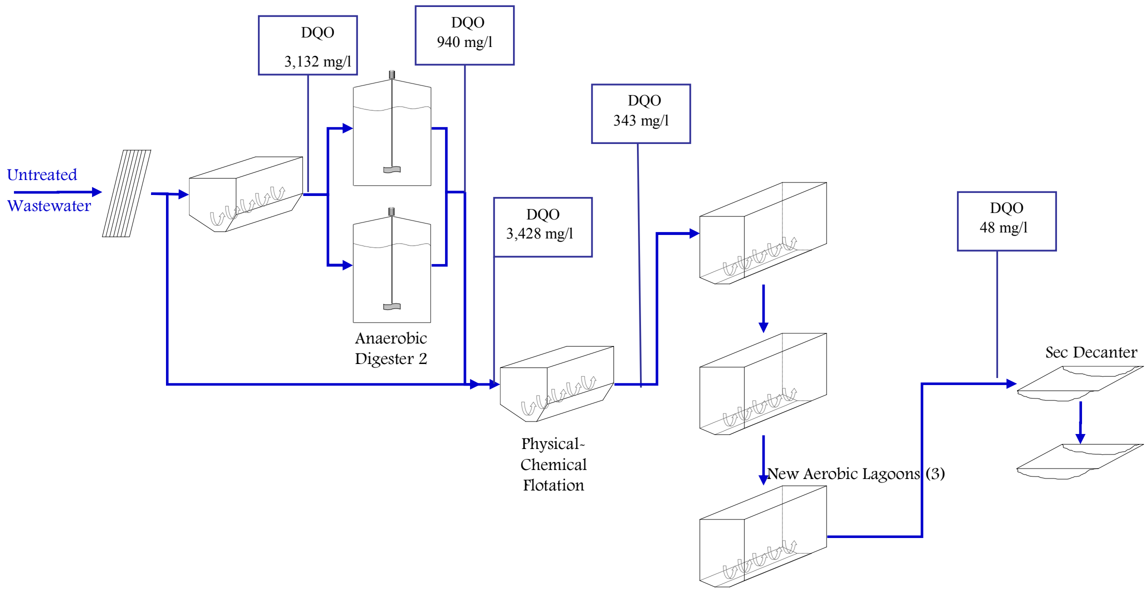


Fig. 13. COD estimated values in each system in the project scenario in the second stage of implementation.
Source: Project Owner

As per AMS.I.D:

1. The project proponent will not install a specific electricity meter for electricity consumption of equipment installed in the project activity. Electricity consumption of project equipment will be conservatively determined by means of the total installed capacity of relevant equipment in the second stage of implementation of the project. It will be assumed that all relevant electrical equipment will be operating at full rated capacity.

According to AMS III.H, distribution losses will be accounted (10%). Considering these distribution losses, the electricity consumed by the project equipment is calculated according to installed capacity in this second stage:

Stage 2

	nº	Power (HP)	Power (kW)
Agitation pumps	2	10	14.7
Aeration equipment in aerated lagoons			
Aerated lagoon 1	2	7.5	11.025
	1	20	14.7
Aerated lagoon 2	4	15	44.1
	1	20	14.7
Aerated lagoon 3	2	7.5	11.025
	1	20	14.7
Distribution losses	10%		12.495
		Total	137.445

$$PE_{power,y} = 0.137445MW * 24h/day * 365d/year * EF;$$

$$PE_{power,y} = 1,188.59 * 0.1842tCO_2/year;$$

$$PE_{power,y} = 219tCO_2/year$$

In order to properly calculate project emissions due to power consumption of project equipment, an equipment inventory will be done once a year and project equipment with their installed power will be updated.

The project is not expected to export electricity to the grid, but partially feed the electricity requirements in the industrial plant. However, an electricity meter will be installed in the project activity to measure the electricity exported to the grid.

As per AMS.III.H:

1. $PE_{ww,y,treated} = Q_{y,ww} * COD_{y,ww,removed} * B_{o,ww} * MCF_{ww,final} * GWP_{CH_4} * UF;$

During the second stage of the project implementation, there is no anaerobic system or any system potentially emitting methane, without biogas recovery system.

$$PE_{ww,y,treated} = 0 tonnesCO_2 / year;$$

2. $PE_{fugitive,y} = (1 - CFE_{ww}) * MEP_{y,ww,treatment} * GWP_{CH_4};$

The only systems with biogas recovery equipment are the bio-digesters. Water flow in biodigesters is $80m^3/h$ and COD removal is 2,192mg/l.

$$MEP_{y,ww,treatment} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,untreated} * UF;$$
$$MEP_{y,ww,treatment} = 529,920 m^3 / year * 2.192e^{-3} tCOD / m^3 * 0.21 tCH_4 / tCOD * 0.8 * 1.06;$$
$$MEP_{y,ww,treatment} = 206.90 tCH_4 / year;$$

$$PE_{fugitive,y} = (1 - 0.9) * 206.90 tCH_4 / year * 21 tCO_2 / tCH_4;$$
$$PE_{fugitive,y} = 434 tonnesCO_2 / year;$$

3. $PE_{discharge,y} = Q_{y,ww} * COD_{discharge} * MCF_{discharge} * B_{o,ww} * UF * GWP_{CH_4};$

Methane emissions from degradable organic carbon in treated wastewater. The treated water discharge is done on the new aerated treatment system. According to the methodology, methane correction factor is equal to zero. Hence, this figure is zero.

$$PE_{discharge,y} = 0 tCO_2 / year;$$

Project emissions for stage 2 of the project implementation, as per AMS.III.H:

$$PE_y = 434 tCO_2 / year;$$

Project emissions as per AMS.III-I:

1. $PE_{ww,y,treatment} = \sum (Q_{y,ww} * COD_{y,ww,removed} * MCF_{ww,final}) * B_{o,ww} * GWP_{CH_4} * UF_{PJ}$;

The biological treatments related to the aerated systems are the physical chemical flotation tank and the new aerated lagoons well managed. According to the applicable methodology, AMS.III-I, the Methane Correction Factor for this situation is zero.

$$PE_{ww,y,treatment} = \sum (Q_{y,ww} * COD_{y,ww,removed} * MCF_{ww,final}) * B_{o,ww} * GWP_{CH_4} * UF_{PJ}$$
$$PE_{ww,y,treatment} = 0tCO_2 / year;$$

2. $PE_{discharge,y} = Q_{y,ww} * COD_{discharge} * MCF_{discharge} * B_{o,ww} * UF_{PJ} * GWP_{CH_4}$;

Treated water discharge from aerated system occurs on the new secondary decanter, with a COD estimated of 48 mg/l according to the minimum efficiency of equipment stated in the Environmental Control Plan. The water flow considered is the whole inflow, 350m3/h, in order to be as conservative as possible. As the decanter is deeper than 2 meters, the methane correction factor is 0.8 as per AMS III.I.

$$PE_{discharge,y} = 2{,}318{,}400m^3 / year * 0.048e^{-3}tCOD / m^3 * 0.8 * 0.21tCH_4 / tCOD * 1.06 * 21tCO_2 / tCH_4;$$
$$PE_{discharge,y} = 321tCO_2 / year;$$

Project emissions due to the turning from anaerobic to aerated lagoon:

The following table summarizes the project emissions for the second stage of implementation, considering the progressive increase of water flow.

	Project Emissions
III.H	434
I.D	219
III.I	321
Total	974

Leakage emissions for stage 2 of the project implementation:

According to the applicable AMS.III.H, “if the used technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered and estimated”. There is no transfer of equipment suitable to be eligible under AMS.III.H associated to the proposed project activity. Hence, leakage can be considered equal to zero.

$$LE_y(AMS\_III.H) = 0CO_2 / year;$$

According to AMS.III.I, “if the aerobic treatment technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered”. Some aeration equipment are transferred from the previous system to the new one. However, in order to be conservative, the project proponent has considered them as project activity equipment and the emissions due to power consumption have been accounted as project emissions. Hence, since there are no other transfer of equipment Since there is no transfer of equipment associated to the proposed project activity, leakage can be considered equal to zero.

$$LE_y(AMS\_III.I) = 0CO_2 / year;$$

Emission reductions calculation will be done ex-post and based in the monitored data of the project activity.

The following table summarizes the ex ante estimation of emission reductions in the second stage of implementation of the project on a yearly basis.

	Baseline Emissions	Project Emissions	Leakage Emissions	Emissions Reductions
III.H	5,504	434	0	5,070
I.D	255	219	0	36
III.I	17,258	321	0	16,937
Total	23,017	974	0	22,043

B.6.4 Summary of the ex-ante estimation of emission reductions:

Summary of emissions calculation:

The explanation above considers a one-year basis period for each stage and the maximum wastewater inflow for stage 2.

In the following table, emissions have been calculated according to the expected schedule of implementation of each stage and according to the foreseen wastewater flow increase. Summary is shown considering the starting date of the crediting period on 01/11/2010.

Year	Baseline Emissions			Total	Project Emissions			Total	Leakage Emissions			Total	Emission Reductions			Total
	AMS III.H	AMS.I.D	AMS.III.I	BE	AMS III.H	AMS.I.D	AMS.III.I	PE	AMS III.H	AMS.I.D	AMS.III.I	LE	AMS III.H	AMS.I.D	AMS.III.I	ER
Nov-Dec 2010	917	42	1,518	2,478	72	36	28	137	0	0	0	0	845	6	1,490	2,341
2011	5,504	255	15,420	21,179	434	219	287	940	0	0	0	0	5,070	36	15,134	20,239
2012	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2013	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2014	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2015	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2016	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2017	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2018	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
2019	5,504	255	17,258	23,017	434	219	321	974	0	0	0	0	5,070	36	16,937	22,043
Jan-Oct 2020	4,587	212	14,382	19,181	362	182	267	812	0	0	0	0	4,225	30	14,114	18,369
				226,975				9,682				0	**Total Emission Reductions**			**217,293**

Table 2. Summary of emission reduction calculation due to the implementation of the project activity.

Year	Estimation of Project Activity Emissions (tCO_2/year)	Estimation of Baseline Emissions (tCO_2/year)	Estimation of Leakages (tCO_2/year)	Estimation of Emission Reductions (tCO_2/year)
Nov -Dec 2010	137	2,478	0	2,341
2011	940	21,179	0	20,239
2012	974	23,017	0	22,043
2013	974	23,017	0	22,043
2014	974	23,017	0	22,043
2015	974	23,017	0	22,043
2016	974	23,017	0	22,043
2017	974	23,017	0	22,043
2018	974	23,017	0	22,043
2019	974	23,017	0	22,043
Jan-Oct 2020	812	19,181	0	18,369
Total (tonnes)			**0**	

B.7 Application of a monitoring methodology and description of the monitoring plan:

According to AMS III.H, the project proponents shall maintain a biogas (or methane) balance based on:

(a) Continuous measurement of the amount of biogas captured at the wastewater treatment system;
(b) Continuous measurement of the amount of biogas used for various purposes in the project activity: e.g. heat, electricity, flare, hydrogen production, injection into natural gas distribution grid, etc. The difference is considered as loss due to physical leakage and deducted from the emission reductions.

As indicated before, the project proponent will not apply for the emission reductions produced by the flaring of biogas in the open flare. Only biogas combusted in the power engines installed for electricity generation will be accounted. Hence, only the biogas used in the mentioned purposes (power generation engines) will be accounted. Thus, since the PP is not applying for ER due to biogas flared but those due to biogas used for power generation, only this biogas flow will be monitored.

According to this, monitoring will not refer to flare operation parameters nor to the “tool to determine project emissions from flaring gases containing methane”.

According to AMS.III.I monitoring shall involve:

(a) *The amount of COD treated in the wastewater treatment plant(s) (CODin, CODout, CODww, discharge,y, CODremoved,k,y) shall be measured regularly in accordance to national or international standards. The amount of wastewater entering and/or exiting the project activity shall be monitored continuously and recorded to provide the total volume of wastewater treated*;
   a. The COD will be measured in accordance with international standards.
   b. The amount of wastewater entering the treatment, which is the same that the outflow, will be monitored to provide the total volume of wastewater treated.

(b) The yearly amount of sludge produced and sludge generation ratio (Sl,PJ,y, Sfinal,PJ,y and SGRPJ) shall be measured. In case of sludge extracted in a slurry phase, the volume (m3) and dry matter content (tonnes/m3) shall be used to calculate Sl,PJ,y. In case of sludge removal as solids,Sj, PJ,y is measured by direct weighing and measuring its dry matter content through sampling;
   a. As indicated before, there will not be any sludge generation in the project activity.

(c) *The amount of fossil fuel and electricity used by the project activity facilities*.
   a. The amount of electricity used by the project activity will be monitored by means of installed capacity, in a conservative approach, of project equipment installed. Project equipment will be inventoried every year.
   b. Electricity generated from biogas engines will be monitored.
   c. Since there is not a specific meter for project equipment power consumption, the PP will monitor the installed equipment in the project activity once a year. The installed capacity operating at 100% rate and 8760 hours per year, plus a 10% accounting on distribution losses, will be considered the power consumption of project equipment. No fossil fuel is to be consumed by the equipment installed in the project activity.

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{BL,y}$
Data unit:	kWh per year;
Description:	Electricity generated by the renewable source in the project activity in the year "y"
Source of data to be used:	Measured by the Project Owner;
Description of measurement methods and procedures to be applied:	The net electricity generated by the biogas engines will be measured by electricity meters installed after each engine. Electricity meters will measure every few seconds, being in compliance and more accurate than the requirements in AMS.I.D (hourly measurements). The cumulative electricity generated will be recorded monthly and these records will be gathered by the Plant Manager, who will maintain all the records in the electronic and paper mode. The Plant manager will prepare and submit a Monthly Report to the Management where data regarding electricity generation will be included. All Monthly Reports will be documented and stored in the Project Office. Class I accuracy electricity meters will be installed in the project.
QA/QC procedures to be applied:	Since this measurement is critical for calculating the emissions reduction, this variable is strictly monitored at the site by means of accurately calibrated electricity meters. Electricity meters installed in the power plant will be calibrated as per manufacturer specifications.
Any comment:	Please, refer to section B.7.2 for the location of metering apparatus

Data / Parameter:	EC_y
Data unit:	kWh per year;
Description:	Power consumed by the Project Activity in the year "y"
Source of data to be used:	Measured by the Project Owner;
Description of measurement methods and procedures to be applied:	Since there will not be installed an electricity meter for proper measurement of project equipment electricity consumption, the project proponent will determine the electricity consumption of the project equipment by means of the installed capacity, assuming that all relevant electrical equipment operates at full rated capacity and 8760 hours per year and considering 10% of distribution losses. Yearly, an inventory for the project equipment will be done and installed capacity will be monitored.
QA/QC procedures to be applied:	An annual inventory of project equipment will be done and stored in the project office.
Any comment:	-

Data / Parameter:	$EC_{y,grid}$
Data unit:	kWh per year;
Description:	Net electricity supplied to the grid by the Project Activity in the year "y"
Source of data to be used:	Measured by the Project Owner;
Description of measurement methods and procedures to be applied:	A specific electricity meter will be installed to measure the output electricity sent to the grid from the biogas engines. The project is not supposed to export electricity to the grid, but this will be monitored by means of an electricity meter. The electricity meter will measure every few seconds, being in compliance and more accurate than the requirements in AMS.I.D (hourly measurements). The cumulative electricity generated will be recorded monthly and these records will be gathered by the Plant Manager, who will maintain all the records in the electronic and paper mode. The Plant manager will prepare and submit a Monthly Report to the Management where data regarding electricity generation will be included. All Monthly Reports will be documented and stored in the Project Office.
QA/QC procedures to be applied:	This measurement is critical for calculating ER. This variable is strictly monitored at the site by means of accurately calibrated electricity meters. Electricity meters installed will be periodically calibrated as per manufacturer specifications. Class I accuracy electricity meters will be installed in the project. According to AMS.I.D version 15, measurement results will be cross checked with records for sold electricity and/or invoices every month.
Any comment:	Please, refer to section B.7.2 for the location of metering apparatus

Data / Parameter:	$Q_{y,ww,i}$
Data unit:	m^3
Description:	Volume of wastewater treated in project situation in the year y. This value is the same as the wastewater outflow
Source of data to be used:	Measured by the Project Owner;
Description of measurement methods and procedures to be applied:	A Parshall type flowmeter will be installed in the project site for measuring the inlet flow considered in the emission reduction calculations. The Parshall flowmeter will be connected to a PLC and will register instantaneous measures every hour and cumulative measures will be gathered at the end of each day. All data will be gathered in electronic mode. The Plant Manager will prepare and submit a Monthly Report to the Management where all data regarding wastewater inflow will be included. Every Monthly Report will be documented and stored in the Project Office.
QA/QC procedures to be applied:	The Parshall throat itself cannot be calibrated since it is a narrowing of the water channel. When electronic measurement devices will be installed in the Parshall flume for measuring the water flow, these devices (sensor) will be calibrated as per manufacturer specifications.
Any comment:	Please, refer to section B.7.2 for the location of metering apparatus. Parshall flume operational accuracy is ± 0.2% of measured distance + 0.05% of range, as specified in technical specifications.

Data / Parameter:	$COD_{y,i,ww,untreated}$
Data unit:	$mg/^l$
Description:	Chemical oxygen demand of inflow wastewater in the system i in year y;
Source of data to be used:	Measured by the Project Owner;
Description of measurement methods and procedures to be applied:	The Standard Method for the Examination of Water and Wastewater (American Public Health Association) will be used for the analysis.
Monitoring frequency:	Inlet water COD will be measured periodically every 15 days by on site manual sampling.
QA/QC procedures to be applied:	Once every 45 days, a sample will be sent to a third party for the cross check.
Any comment:	Please, refer to section B.7.2 for the location of the metering apparatus. Please, refer also to annex 4 for the sampling method undertaken.

Data / Parameter:	$COD_{y,ww,treated,i}$
Data unit:	kg/ m3
Description:	Chemical Oxygen Demand of the wastewater treated by system i in the project situation in the year y;
Source of data to be used:	Cooperativa Lar monitoring and register.
Measurement procedures:	COD of the wastewater treated in a treatment system is the same as outlet COD from system i. This parameter will be measured after each treatment system in the project boundary by on site manual sampling. The Standard Method for the Examination of Water and Wastewater (American Public Health Association) will be used for the analysis.
Monitoring frequency:	Outlet water COD will be measured periodically twice a month by on site manual sampling
QA/QC procedures to be applied:	Once every 45 days, a sample will be sent to a third party for the cross check.
Any comment:	Please, refer to section B.7.2 for the location of the metering apparatus in each stage of implementation of the project activity. Please, refer also to annex 4 for the sampling method undertaken. This parameter is equivalent to $COD_{ww,untreated,y,i}$ in the immediately next system and to $COD_{ww,discharge,PJ,k,y}$ when system i is the last system affected by the project activity.

Note: the COD untreated measured for one system is equal to COD treated of the immediately previous system when installed serial

Note: COD discharge is equal to COD treated of the last treatment system included in the project boundary. I.e, COD treated (new aerated lagoon) = COD discharge (as per AMS.III.I) in stage 1.

Data / Parameter:	$COD_{ww, removed,PJ,k,y}$
Data unit:	Tonnes/m^3
Description:	COD removed by project treatment system k in year y
Source of data to be used:	Calculated from ($COD_{y,i,ww,untreated}$ - $COD_{y,i,ww,treated}$)
Description of measurement methods and procedures to be applied:	Intlet water COD will be measured periodically twice a month by on site manual sampling. The Standard Method for the Examination of Water and Wastewater (American Public Health Association) will be used for the analysis. Results from the measurement will be gathered by the Plant Manager in electronic and paper mode. The Plant Manager will prepare and submit a Monthly Report to the Management where all data regarding COD of inflow wastewater, will be included. Every Monthly Report will be documented and stored in the Project Office.
QA/QC procedures to be applied:	Calculated periodically based on the available measurements of COD.
Any comment:	-

Data / Parameter:	EF_{OM}
Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin Emission Factor for Grid Electricity during the year y;
Source of data used:	Ministry of Science and Technology of Brazil. (Ministerio da Ciencia & Tecnologia do Brasil), *http://www.mct.gov.br/index.php/content/view/74691.html*
Value applied:	0.2909
Description of measurement methods and procedures to be applied:	Official EFOM from the Ministry of Science and Technology of Brazil is calculated as per the “Tool to calculate the emission factor from an electricity system”
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	EF_{BM}
Data unit:	tCO_2/MWh
Description:	CO2 Building Margin Emission Factor for Grid Electricity during the year y;
Source of data used:	Ministry of Science and Technology of Brazil (Ministerio da Ciencia & Tecnologia do Brasil) http://www.mct.gov.br/index.php/content/view/74691.html
Description of measurement methods and procedures to be applied:	Official BM from the Ministry of Science and Technology of Brazil, calculated as per the "Tool to calculate the emission factor from an electricity system"
Value applied:	0.0775
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	EF_{grid} (CM)
Data unit:	tCO_2/MWh
Description:	CO_2 Combined Margin Emission Factor for Grid Electricity during the year y;
Source of data used:	Ministerio da Ciencia & Tecnologia do Brasil, http://www.mct.gov.br/index.php/content/view/74691.html
Description of measurement methods and procedures to be applied:	Official OM from the Ministerio da Ciencia & Tecnologia do Brasil, calculated as per the "Tool to calculate the emission factor from an electricity system"
Value applied:	0.1842
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$V_{biogas,y}$
Data unit:	Nm^3
Description:	Volume of biogas recovered in the year y;
Source of data to be used:	Cooperativa Lar monitoring and register.
Measurement procedures:	According to the applicable methodology, the amount of biogas recovered is to be monitored with mass flowmeters. As explained above, since the PP are not applying for ER due to flaring of biogas recovered but only for the part of biogas recovered which is used for electricity generation, the only volume of biogas monitored will be the biogas to engines, which is the one for which ER are being applied. At least one flowmeter will be installed for metering the biogas inflow to engines, including the biogas derived to the engines (not necessarily one flowmeter for each engine), in dry basis Data will be gathered in electronic and paper mode.
Monitoring frequency:	Mass thermal flowmeter with temperature and pressure correction, giving measurements in Nm3 will be used. Measurement values and time will be sent to a PLC. Project participants may use one hour or smaller discrete intervals for measurement.
QA/QC procedures to be applied:	Flow meters used for these measurements will be periodically calibrated as per manufacturer instructions.
Any comment:	-

Data / Parameter:	$w_{ch4,ww}$
Data unit:	Dimensionless
Description:	Methane fraction in biogas
Source of data to be used:	Cooperativa Lar monitoring and register.
Measurement procedures:	A continuous gas analyzer will be used for monitoring the methane fraction in biogas in dry basis.
Monitoring frequency:	Continuous analyzer will be used.
QA/QC procedures to be applied:	The analyzer used for these measurements will be periodically calibrated as per manufacturer instructions.
Any comment:	The simplified approach is chosen. Only the methane content will be monitored and the difference is considered to be nitrogen.

B.7.2 Description of the monitoring plan:

The project activity and the monitoring plan will be developed by Cooperativa Agroindustrial Lar. This serious involvement of the company in the CDM project activity will ensure a safe operation of the plant as well as the correct monitoring of the emissions reduction accounted from the implementation of the project activity. Monitoring will start to be implemented with stage 1 of implementation.

Monitoring plan is designed in order to strictly control each and every relevant data regarding the emission reductions. Methane emissions are avoided through three ways:

1. Methane emissions avoided by methane recovered in biodigesters and used for electricity generation in biogas engines;
2. Methane emissions avoided through turning the anaerobic open lagoons into the aireation treatment;
3. CO_2 emissions avoided through grid electricity displacement from power generation in biogas engines;

For accounting points 1 and 2, water flow and COD before and after each treatment system affected by the project activity should be measured.

Measures of water flow are taken with Parshall flow meters installed as shown in the following figure. For measuring COD, water samples are taken at the indicated points and are analysed.

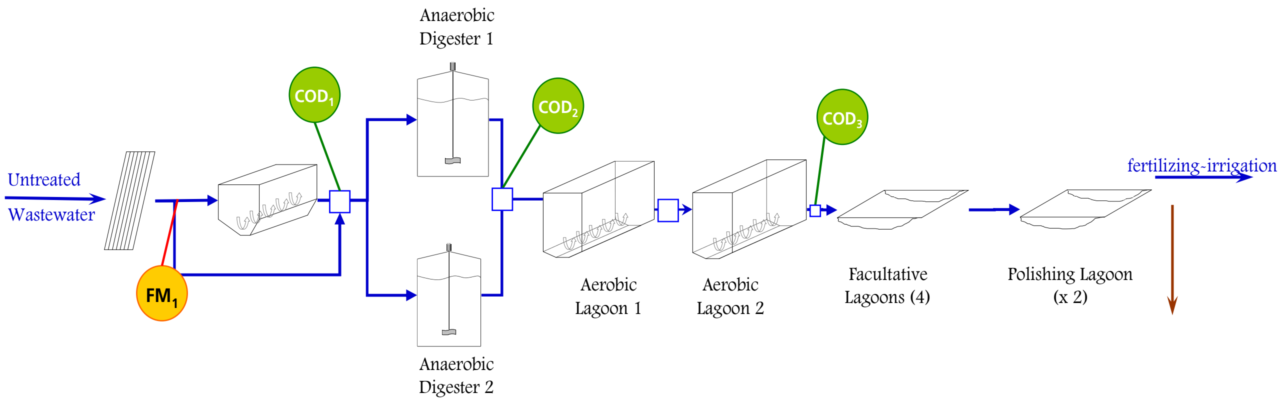


Fig. 14. Location of the monitoring points in the first stage of implementation.

Where:

FM: Flow meter;
COD: Sampling point for COD analysis;

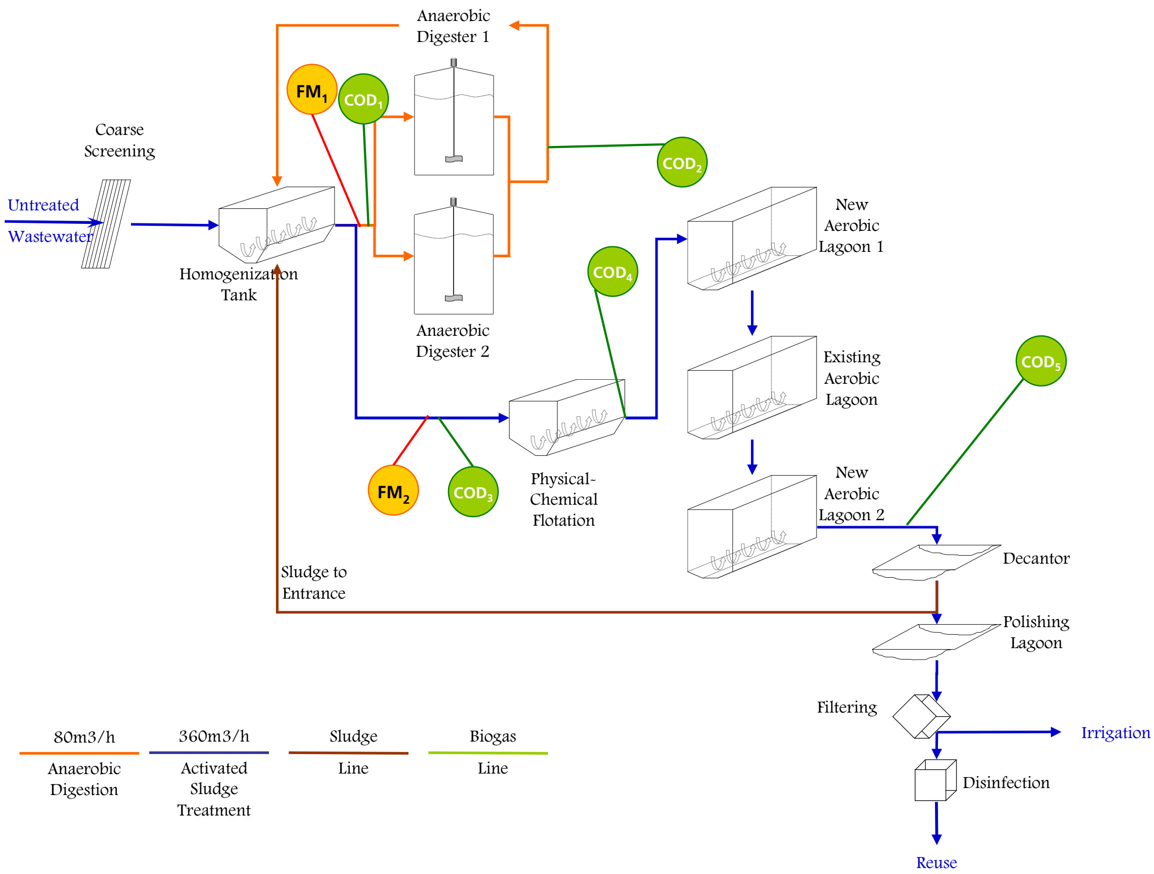


Fig. 15. Location of the monitoring points in the second stage of implementation

Aerobic conditions in the PC Flotation tank:

According to paragraph 22 of the methodology AMS.III.I version 08, *in case a MCF value of zero is adopted for the project wastewater treatment system assuming that it is a well managed aerobic system, its operation shall be documented in a quality control program. This shall include monitoring of the operating conditions of the treatment system and procedures to verify if they are within the specified range so as that to ensure the aerobic condition of the reactors. One of the two options below shall be used:*

- *The acceptable range of operational parameters (e.g., running time of aerators, flows, COD loads) are defined for continuous aerobic operation of the treatment system kept within the limits of the in accordance with the engineering design parameters of the wastewater treatment system and reported in the PDD. The operational parameters are then continuously monitored to ensure that they are always kept in the design range of operating conditions.*
- *Dissolved oxygen (DO) shall be monitored either continuously or on a sample basis (use 90/10 precision for sampling) to demonstrate that there are no anaerobic pockets (DO level shall be 1 mg/L or above) in the reactor during operation.*

In case the operational parameters are not within the limits for a period of time, a MCF value of 0.3 shall be taken for that period.

In case existence of anaerobic pockets is indicated by a measurement of low DO value (less than 1mg/L) then a MCF value of 0.3 shall be taken for the period of time between the previousmeasurement and this current measurement.

In the PCF Tank, there is no chance for methane generation due to the inherent operation of the system. Aerobic conditions in the PC Flotation tank are ensured due to its own nature. It is a Dissolved Air Flotation tank, where pressure of injected air is adjusted to the removal efficiency indicated in the Environmental Control Plan (PCA).

The retention time in the PC Flotation tank is less than one hour for a peak flow of 350m3/h

Volume of tank = 157.4 m3 (PCA);
Flow = 350 m3/h;
Retention time = 157,4/350 = 0.44h = 26.4 min.

No anaerobic degradation can occur in this short gap of time, with or without aeration. This already ensure that wastewater degradation in the PC Flotation tank will never be anaerobic since the hydrolysis, acid formation and methanization of wastewater requires a minimum retention time which is recommended to be between 2 and 5 days, but half an hour is not enough for this degradation to happen. Several references of recommendations and typical values for retention time in anaerobic lagoons have been submitted to the validation team.

However the statement above, the operational conditions in the PCF tank will be monitored in order to ensure that the COD loads are in an acceptable range and within the design parameters of the wastewater treatment system and reported in the PDD, as per the methodology.

Apart from this, the removal efficiency will be measured periodically through the analysis of wastewater samples in the inlet and outlet water flow in the tank. PC Flotation tank is designed to operate under specific aeration conditions. If aeration does not work properly, aerobic metabolism of bacteria will not be efficient and removal will be deficient. Hence, COD values in the outlet flow will show inefficiencies in the aeration system, but never anaerobic conditions, which are not possible with hydraulic retention times under several days in an open lagoon.

Accounting point 3, CO_2 emissions avoided through power displaced from the grid by the generation of electricity from renewable biogas recovered, electricity meters will be installed within the project boundary in order to measure electricity generated with biogas engines and electricity exported to the grid.

Each engine, each aerator, each and every equipment within the project boundary is connected to a Control Board. In these control boards, electricity meters will be installed in order to measure electricity consumption of the project activity.

The output power generated in each biogas engine will also be measured through electricity meters, as shown in the figure below. Gross electricity generated will be the sum up of the electricity generated by each engine.

A brief explanation of the connection of the electricity measurement equipment is provided below.

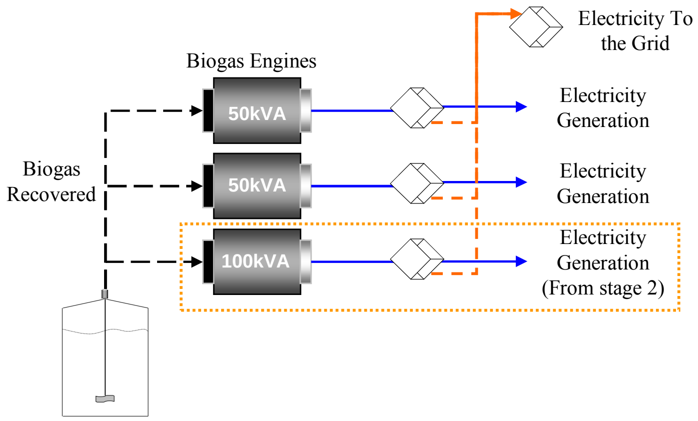


Fig. 16. Installation of electricity meters within the project boundary.

As it was explained before, the project promoter will not apply for the emission reductions from the biogas flared in the safety torch, thus considering that this biogas is not flared at all (or, what is the same, considering a flare efficiency of zero). Hence, there will not be any monitoring of the biogas flared in the torch. Only biogas flow to the power engines and the methane content in it will be monitored.

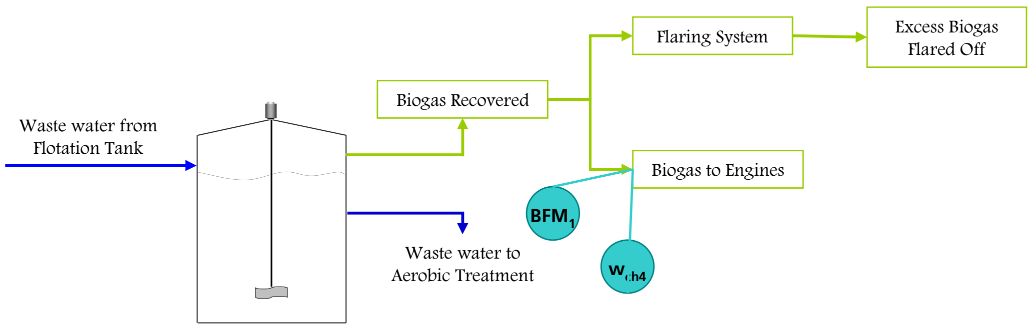


Fig. 17. Location of the monitoring points for flaring gases containing methane

Where:

w_{CH4}: Biogas monitoring (volumetric fraction of methane in the residual gas in the hour h);
BFM: Biogas flowmeter (Volumetric flow rate of the residual gas in dry basis at normal conditions). There will be at least one flowmeter to measure the whole biogas flow to engines (not one flowmeter for each engine);

As it has been explained, the project proponent has relinquished to apply for the emission reductions from biogas flared in the open flare. The only emission reductions which will be taken into account will be those resulting from power generation in biogas engines and from methane avoidance when switching the anaerobic lagoons into aerated lagoons. Hence, the emission reduction resulting from biogas will be based on the amount of methane recovered in biodigesters that is used for power generation in engines.

Cooperativa Agroindustrial Lar will implement a responsible monitoring by assigning specific trained staff for monitoring, measurement and reporting of the key parameters identified in this PDD.

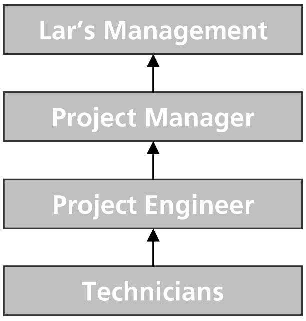
The project proponent, in order to properly monitor all the relevant data during the crediting period, has developed a Monitoring Protocol which includes the following:

- Overall Project Management;
- Internal data collection procedures;
- Calibration and maintenance of equipment;
- Training procedures;
- Internal audit procedures;

Data and parameters which will be monitored under this Monitoring Plan will be measured and strictly monitored at the project site by means of accurately calibrated instruments.

Operational Structure of the Monitoring Plan. Overall project management:

The Monitoring Plan structure and the roles of the different members involved in the Monitoring Plan are shown below**.**



Project Manager: The PM will be the responsible of the correct implementation of the monitoring plan. With all the relevant data monitored, the PM will generate a Monthly Report which will be submitted to the company's Management.
PM will also be the responsible of the appointment of the accredited laboratory (third party) for the monthl "off-site" wastewater analysis for cross-checking.

Project engineer: The PE will be the responsible of the management of all the practical work of the project concerning the monitoring activities.
PE will implement and control the measurements, the data gathering, the reporting to the PM, the maintenance and calibration of the equipment, always assisted by the technicians in the plant.

Technicians: The technicians will be responsible for the daily operation and maintenance of the equipment concerning the monitoring plan, which will be a part of their normal procedures of operation.

Internal data collection procedures:

Data collection and gathering is critical for the monitoring plan and, hence, for the accounting of emission reduction due to the implementation of the project activity. Since this stage is critical, internal procedures for data collection will be developed under a specific guidance for monitoring.

- This monitoring guidance will describe all necessary methods and procedures concerning monitoring, measurements, data collection, recording, gathering (on hard and soft copy), calibration, third party cross-checks, etc…
- The monitoring guidance will take into account all the conditions for the measurement methods and procedures, and will reflect the QA/QC procedures as stated in the PDD;
- Preventive actions for maintenance and corrective actions to be considered in case of failure of equipment will also be reflected in the monitoring guidance;
- As explained before, all monitored data will be gathered in soft and hard copy during the crediting period plus 2 years;

With this monitoring guidance, which intention is to properly and clearly establish the monitoring procedures, the accuracy and reliability of the monitored data will be ensured.

Calibration and maintenance of equipment:
As mentioned, the PM is responsible of the proper maintenance of monitoring equipment. In the monitoring guidance, the calibration procedures will be clearly stated in order to ensure a reliable and accurate measure of the concerning data.

Training procedures:

The project personnel will be trained by the CDM Monitoring Team on procedures, calibrations, reporting and every issued related to monitoring plan development.

Management, Plant Managers and all the staff involved in the project activity will receive training on the principles of the project activity, the monitoring plan (equipment and monitoring structure), quality issues and on the CDM procedures for this project activity.

Technicians will receive a specific training in the plant operation and monitoring activities. The PE will carry out a continuous training at the project site.

Warning sign shall be posted around the equipment, within reach of every employee.

Internal audit procedures:

A Quality Assurance procedure will be undertaken every six months. An internal Audit shall be done in order to ensure the quality of the recorded data and also to ensure that all established steps have been properly followed.

In case of malfunction of equipment, leaks, unintended release of methane, etc, a periodical inspection of equipment will be implemented. This periodical inspection will include a check for leaks, pipeline obstructions, corroded joints and equipment malfunction.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completion: 10/02/10

Zero Emissions Technologies SA
Contact person: Ana Carnal Andrés-Montalvo
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Tel: +34 954 937 111
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Avenida das Américas, 3.500 sala 304, Barra da Tijuca
22640-102 – Rio de Janeiro – RJ
Tel: +55 (21) 81294600
E-mail: zeroemissions@abengoa.com
URL: www.zeroemissions.com

Both, Zero Emissions Technologies SA and Zeroemissions do Brasil Ltda, are also project participants.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

20/06/2008. Starting date of the land preparation works for constructing the biodigesters.
This starting date is in accordance with the CDM Glossary of Terms, being the first real action with significant financial commitments developed in the project activity.

C.1.2. Expected operational lifetime of the project activity:

10 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

N/A

C.2.1.2. Length of the first crediting period:

N/A

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/11/2010 or on the registration date of the project activity, whichever is later.

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The project activity involves two different stages.

During the first implementation stage, there will be covered two of the existing open anaerobic lagoons and corresponding biogas recovery systems will be installed. The generated biogas during the anaerobic digestion of wastewater will be used as a source of energy for electricity generation at specific engines.
In this stage, treated wastewater will be used for fertilizing irrigation, making the most of the nutrients in treated wastewater.

During the implementation of the second phase, production capacity of the Industrial Unit of Chicken will be progressively increased. The wastewater inflow, which in the absence of the project activity would have been treated in the existing anaerobic open lagoons, will be treated in the new aeration lagoons treatment system. This will be possible due to the installation of new aeration equipment which will make it possible to transfer oxygen to the wastewater stream.

Out of the whole water stream, around 30% will be sent to irrigation purposes (fertilizing). The remaining treated water stream will undergo a filtration-disinfection treatment in order to make it suitable to be reused.

The project activity will contribute to the following positive environmental impacts:

- Enhance of a more efficient wastewater treatment;
- Reduction of the overall greenhouse gas emission associated to the water treatment plant;
- Reduction of the odour problems surrounding and within the slaughterhouse;
- Promotion of the use of renewable energy. The recovered biogas will be utilized effectively.
- Reuse of the treated wastewater for irrigation purposes (fert-irrigation);
- Reuse of the treated wastewater after disinfection;
- Promotion of a more environmental friendly image on slaughterhouse industry;

The potential negative environmental impact of the proposed project activity can be considered as negligible. It could probably be associated with the explosion risks from biogas storage or the possible methane leakages and scapes. With the proper design and operation of the biogas storage and burning system and the regular monitoring and maintenance of the system, these risks can be completely mitigated.

According to Brazilian Regulation[76], the modification of an existing wastewater treatment plant does not require an Environmental Impact Analysis. Environmental impact occurs when environmental physical, chemical or biological properties are altered as a consequence of any matter or energy resulting from human activities, which directly or indirectly affect[77]:

- health, safety or well being of nearby communities;
- social-economical activities;
- life:
- sanitary conditions of environment;
- environmental resources quality;

The proposed project activity will improve the nearby zone conditions by reducing methane release to the atmosphere, will reduce odours in the nearby zone and will contribute to reduce power consumption from non-renewable sources by generating electricity from biogas recovered, not causing any negative alteration suitable to be considered under the above mentioned situations, the Environmental Institute of Paraná (Instituto Ambiental do Paraná) issued the Environmental Installation Licence (Licença de Instalaçao) on April, 27th, 2009. With this licence, Cooperativa Lar is in compliance with the environmental regulation of Brazil.

Licença de Instalaçao nº 8.200
Valid until: April, 27th, 2011
Protocol nº. 747 25 988
Instituto Ambiental do Paraná

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

No actions are required.

[76] **Resolução CONAMA** nº 237, de 19 de dezembro de 1997. http://www.siam.mg.gov.br
[77] **Resolução CONAMA** nº 1, de 23 de janeiro de 1986. http://www.siam.mg.gov.br/sla/download.pdf?idNorma=8902

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

Notification on the delay on the stakeholders' invitation as per required by the Brazilian DNA

According to the Brazilian Designated National Authority, *Comissão Interministerial de Mudança Global do Clima*, the project proponent must, in order to obtain the Host Country Letter of Approval, invite to the stakeholders' meeting, at least, the following entities:

- City Hall of each municipality affected (Prefeitura de cada município envolvido);
- City Councilor Camera of each municipality affected. (Câmara dos vereadores de cada município envolvido);
- State Environmental Organ (Órgão ambiental estadual);
- Municipal Environmental Organs (Órgão(ãos) ambiental(is) municipal(is));
- Brazilian Forum of NGO and Social Movement for Environment and Sustainability (Fórum Brasileiro de ONG's e Movimentos Sociais para o Meio Ambiente e Desenvolvimento – FBOMS)
- Community Associations which purpose is related directly or indirectly with the project activity (Associações comunitárias cujas finalidades guardem relação direta ou indireta com a atividade de projeto);
- State Public Ministry of the involved State or Public Ministry of Federal District and Terrritory (Ministério Público estadual do estado envolvido ou, conforme o caso, o Ministério Público do Distrito Federal e Territórios);
- Federal Public Ministry (Ministério Público Federal).

According to the procedures, the project proponent should send the invitation to the above mentioned entities at least 15 days before the validation process starts in order to guarantee that any comment launched by the affected entities, could be added to the PDD and, thus, considered by the DNA in the LoA issuance process.

The project proponent invited only some of the above mentioned entities to the stakeholders' meeting celebrated on February, 19th, 2009 and representative of some of them attended the meeting, as it is specified below.

The project was hosted for GSP at UNFCCC website on May, 15th, 2009 and the site visit took place on 1st -4th July, 2009. During the site visit, the project proponent realized that some required invitations were not sent before the stakeholders' meeting. Although the previous mentioned, some of the required entities were invited and attended to the stakeholders' meeting, as stated in the table below.

On July, 8th, 2009, the project proponent sent a letter to the required entities, inviting them to launch any comment regarding the proposed project activity in order to include those comments in the final version of the PDD, which is the purpose of the DNA.

The acknowledgement of the invitation was received on July, 9th, 2009.

Stakeholders' Meeting invitation and comments

An announcement was published at Cooperativa Agroindustrial Lar's website on February, 2009. Everyday, the comments received were gathered to be considered for the Project development. Finally, the Stakeholders' Meeting was conducted on *February, 19th, 2009, at 10.00h, at "Associacao Recreativa Lar de Matelandia"*.

Apart from being published in Lar's website, the invitation for the Stakeholders' Meeting was specifically sent to some stakeholders.

Lar
COOPERATIVA AGROINDUSTRIAL LAR

Convite

Visando reduzir as emissões de Gases do Efeito Estufa em sua Unidade Industrial de Aves, a **COOPERATIVA AGROINDUSTRIAL LAR** tem a satisfação de convidar Vossa Senhoria para a reunião informativa sobre o projeto MDL, (Mecanismo de Desenvolvimento Limpo).

O objetivo deste projeto é o tratamento de águas residuais e geração de energia elétrica a partir do Biogás.

Data : 19 de Fevereiro de 2009.
Horário : 10:00 horas
Endereço : Rodovia 277 Km 653.
Associação Recreativa Lar de Matelândia – PR.

Contamos com a sua presença

Irineo da Costa Rodrigues
Diretor Presidente

Av. Brasília, 1220 – Cx. Postal, 080 – CEP 85884-000 – Medianeira – PR
Fone (45) 3264 8806 / 8819 – E-mail: secretaria@lar.ind.br / gestaoambiental@lar.ind.br

Fig. 18. Invitation for the Stakeholders' Meeting at Cooperativa Agroindustrial Lar

More than 100 people atended the meeting. A list of assistants is included below.

Name	Company
Edson Primon /	Prefeito Matelândia
Gilmar Motta da Costa	Vice-Prefeito Matelândia
Roberto Câmara	Secretário Meio Ambiente
Ernesto Bado	Presidente Câmara
José de Oliveira da Rocha	Secretário Geral
Enio Roberto Nuglisch	Secretário Municipal de Finanças
Margarete Menoncin Debertolis	Secretaria Municipal de Saúde
Rozane De Fátima Primon	Secretária Municipal De Ação Social E Habitação
Rosane Maria De Costa Marroco Crenitte	Secretária Municipal De Educação E Cultura
Ademar Hass	Secretario Municipal De Obras E Serviços Urbanos
Marcio Becker	Secretario Municipal De Administração
Luiz Antonio Costenaro	Secretario Municipal De Esportes
Ernesto Bado	Presidente Da Câmara Municipal
Edson Alves De Oliveira	Vice – Presidente Da Camara Municipal
Eliete Ponciano Pinto	Vereadora
Kártia Duarte Da Silva	Vereadora
Ademir Graffunder	Vereador
Gilmar Gregório	Vereador
Valdecir Reinheimer	Vereador
Domingos Pandolfo	Vereador
Liria Perini Carnetti	Vereadora
Alcedir Biesdorf	Extencionista da EMATER – Empresa de Assistência Técnica de Extensão Rural de Matelândia
Faustino	Sindicato Rural Matelândia
Tany Razera	Delegada / Matelândia
José Stock	Chefe SEAB – Secretaria Estadual de Abastecimento
José Bucoski	Presidente Sindicato Trabalhadores Rurais
Dario Cozer	Presidente ACIMA – Associação Comercial e Empresaria de Matelândia
Carlos Dias	FAMA – Faculdade de Matelândia
Anacleto Perondi	Presidente APROLI – Associação dos Produtores Rurais Lenheiros ao Parque Nacional do Iguaçu
Neori Peroza	Chefe Dep. Compras
Celso Da Col	Presidente PC do B
Arcencio Rodrigues Filho	Comandante Polícia Militar
Clarito da Silva	Presidente do Conselho
Sérgio Luiz Cadini	Diretor Radio Matelândia
Jackson Bueno	Presidente da Matelândia Administradora de Participações S/A
Valmir Valcarenghi	Presidente Lions Clube
Jair José de Souza	Presidente Rotary Clube

Name	Company
Kelly Daiane Faria	Presidente Partido Verde – PV
Vitor Hugo Burko	Presidente IAP – Instituto Ambiental do Paraná
Dra Ana Cecilia Nowacki	IAP Curitiba
Dra Rossana Baldanzi	IAP Curitiba
Jose Volnei Bisognin	IAP Toledo
Valira	IAP Toledo
Irineu Ribeiro	Chefe Regional IAP Foz do Iguaçu
Adir Parizzotto	SEMA – Secretaria Estadual de Meio Ambiente IAP Toledo
Gumercindo Brito	Chefe Regional Toledo – Superintendência de Desenvolvimento de Recursos Hídricos e Saneamento Ambientas - SUDERHSA
Jorge Pegoraro	Chefe Parque Nacional do Iguaçu IBAMA - Instituto Brasileiro de Meio Ambiente e Recursos Naturais
Outras Instituições e Convidados	
Jorge Miguel Samek	Diretor Geral Brasileiro Itaipu Binacional
Cícero Bley	Itaipu Binacional
Antonio Marcos Hachisuca	ITAI – Instituto de Tecnologia Aplicada e Inovação
Francisco Alves de Oliveira	Copel – Companhia Paranaense de Energia Elétrica
Luiz Antonio Rossafa	Diretoria de Gestão Corporativa Copel
Rubens Ghilardi	Diretor Presidente Copel
Maria Arlete Rosa	Sanepar – Companhia de Saneamento do Paraná
Stenio Sales Jacob	Diretor Presidente Sanepar
Eng º Péricles Weber	Ass. Pesquisa Sanepar
Ibrain	Star Milk
Mario Sossella Filho	Star Milk
Marcos Vilas Boas	Presidente da AMOP – Associação dos Municípios do Oeste do Paraná
Antonio Bau	Reitor do Campus Medianeira UTFPR – Universidade Tecnológica Federal do Paraná
Dr. Henrique	Plano de Saúde Unimed
Eduardo Ferreira	Planotec
Ediwilson Soares	Engenharia Paulo Colpo
Paulo Colpo	Engenharia Paulo Colpo
Alfredo Lang	Cooperativa Agroindustrial Cvale
Dilvo Grolli	Cooperativa Agroindustrial Coopavel
Valter Pitol	Cooperativa Agrícola Consolata Ltda - Copacol
Ricardo Chapla	Cooperativa Agroindustrial Copagril
Edmar Rockenbach	Cooperativa Agroindustrial Cooperlac / Primato
Joao Paulo Koslovski	Ocepar – Sindicato e Organização das Cooperativas do Estado do Paraná
Luiz Roflinger	Cooperativa de Crédito Sicredi
Inacio Prati	Cooperativa de Crédito Sicredi
Aldo Dagostin	Cooperativa de Crédito Sicredi
Ademir Roque	Cooperativa de Crédito Sicredi
Antonio Sobrinho	Cooperativa de Crédito Sicredi

Name	Company
Manfred Alfonso Dasenbrock	Presidente Sicredi Central PR
Moises Pistore	Presidente Cerme – Cooperativa de Eletrificação Rural de Medianeira
Valter Vanzella	Frimesa
Fabiane Bachega	Fomento Frimesa
Mauro Luiz Knebel Groth	Banco do Brasil
Carlos Augusto	BNDES – Banco Nacional do Desenvolvimento Econômico e social
Tiago Pesch	BRDE – Banco Regional de Desenvolvimento do extremo Sul
	Cooperativa Agroindustrial Lar
Conselho ADM	Lar
Conselho Fiscal	Lar
Gerentes de Divisão Administrativo /Financeiro	Oderi da Silva
Gerentes de Divisão Estratégica e Logística	Ademir Pereira da Silva
Gerentes de Divisão de Alimentos e Compras	Jair José Meyer
Gerentes de Divisão Comercial	Mario Tadeu Martins Balk
Gerentes de Divisão Pecuária	Milton José Lochann Bortolini
Gerentes de Divisão Industrial	Reinaldo Fiuza Sobrinho
Valério Canalle	Gerente Unidade de Matelândia Lar
Dirceu Zotti	Gerente Unidade Produtora de Leitões – Itaipulândia Lar
Liderança Coopers	Lar
Dr. Daniel Pinto	Sif - Serviço de Inspeção Federal
Imprensa	
Antonio Vasconcelos	FM e Campos Dourados (Rádio)
Vanderlei Pauleski	Jornal Integração (imprensa escrita)
João Hermes	TVI – Televisão Independente
Ivanir Gebert	Jornal Nossa Folha (imprensa escrita)
Mirtes	Jornal Mensageiro (imprensa escrita)
	Jornal Voz do Paraná (imprensa escrita)
Julio	Gazeta do Paraná (imprensa escrita)
	Radio Jornal SMI (Rádio)
	TV Naipi (Emissora Foz do Iguaçu)
Vandre / Toninho / Iara	Jornal O Paraná (imprensa escrita)
	Rádio Grande Lago (Rádio)
	Rádio União (Rádio)
	TV Cataratas (Foz do Iguaçu)
	Rede Massa (TV Foz do Iguaçu)
Mauricio Freire	Caminhos Do Oeste do Paraná (Programa TV)
	Rádio Independência (Rádio)

E.2. Summary of the comments received:

The Chairman of Cooperativa Agroindustrial Lar welcome the local stakeholders and started with a short presentation about the company and the environmental commitment which has driven Cooperativa Agroindustrial Lar to develop the proposed project activity under the CDM.

After the introduction, the proposed project activity was explained to the local stakeholders, taking special care in the methodology to be used and the technical and environmental characteristics. Attendants asked in the meeting about the process, the GHG reduction and about the CDM process.

Comments made during the stakeholders' meeting were very general and none was negative.

In conclusion, no adverse comments were received regarding the proposed project activity.

E.3. Report on how due account was taken of any comments received:

Since there was no adverse comment concerning the proposed project, the project participant concluded that the proposed activity will be welcome and will be considered an example for other companies in the region, which may replicate the process at their facilities.

Every doubt about technicals and process were solved by the specialists representing the project participant, in such a way that every stakeholder and every similar industry will find it interesting and attractive to implement a similar process at their facilities.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	**Cooperativa Agroindustrial Lar**
Street/P.O.Box:	Avenida Brasilia, nº 1220, Condá
Building:	
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State/Region:	Paranà
Postfix/ZIP:	85884-000
Country:	Brazil
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FAX:	+55 (45) 3264 8801
E-Mail:	irineo@lar.ind.br
URL:	
Represented by:	Irineo da Costa Rodrigues
Title:	Diretor Presidente
Salutation:	Mr.
Last Name:	Rodrigues
Middle Name:	da Costa
First Name:	Irineo
Department:	-
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Direct FAX:	+55 (45) 3264 8801
Direct tel:	
Personal E-Mail:	abnsberto@lar.ind.br

Organization:	**Zeroemissions do Brasil Ltda**
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Building:	Ed. Toronto 1000, Condominio Le Monde
City:	Barra da Tijuca, Rio de Janeiro.
State/Region:	RJ
Postfix/ZIP:	CEP: 22640-102
Country:	Brazil
Telephone:	(55) 21 3242 5040
FAX:	(55) 21 3242 5040
E-Mail:	zeroemissions@abengoa.com
URL:	http://www.zeroemissions.com
Represented by:	Emilio Rodríguez-Izquierdo Serrano
Title:	General Manager
Salutation:	Mr.
Last Name:	Serrano
Middle Name:	Rodríguez-Izquierdo
First Name:	Emilio
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Organization:	**Zero Emissions Technologies SA**
Street/P.O.Box:	Campus Palmas Altas
Building:	Building B. 1st Floor
City:	Seville
State/Region:	Andalucía, Spain
Postfix/ZIP:	41014
Country:	Spain
Telephone:	(+34) 954 937 111
FAX:	(+34) 647 812 610
E-Mail:	zeroemissions@abengoa.com, antonio.marin@zeroemissions.abengoa.com
URL:	http://www.zeroemissions.com
Represented by:	Emilio Rodriguez-Izquierdo Serrano
Title:	General Manager
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Middle Name:	Rodriguez-Izquierdo
First Name:	Emilio
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	zeroemissions@abengoa.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No Official Development Assistance (ODA) was involved in this project.

Annex 3

BASELINE INFORMATION

Baseline has already been discussed in section B.6.1.

Annex 4

MONITORING INFORMATION

Monitoring plan has already been discussed in section B.7.2

Application of the General Guidelines for Sampling and Surveys for Small Scale CDM Project Activities (EB 50, Annex 30)

Sampling size determination

The outlet COD from each treatment system is a critical parameter that directly affects the calculation of emission reductions. The value considered for ER calculation is the annual mean of COD outlet from each treatment system affected by the project activity, which is calculated from a sample of COD measurements taken during the year.

According to the "*General Guidelines for Sampling and Surveys for Small Scale CDM Project Activities"*, EB50, Annex30, project participants are required to use a 90/10 confidence/precision as the criteria for reliability of sampling efforts where there is no specific guidance in the applicable methodology.

In order to be in accordance with these guidelines, the project participant has considered the previous year's data for COD and has calculated the minimum sample size to ensure that the annual mean represents the mean COD with a confidence of 90% and a precision of 10% over the mean.

According to the "Central Theorem of Limit", the mean of a sufficiently large number of independent random variables, each with finite mean and variance, will be approximately normally distributed[78] (Rice, 1995)

The variable "*COD*" is independent (one sample does not affect others) and has a finite mean and variance, hence, it can be assumed that COD follows a Normal (Gauss) distribution with known mean (μ) and variance (σ), from the previous year's analyses.

COD ~ N(μ,σ)

From this assumption, the confidence interval and precision for COD established by the EB Guidelines is accomplished by determining sample size for the annual mean of COD according to the Normal distribution characteristics and the requirements for confidence/precision.

[78] Central Limit Theorem: http://en.wikipedia.org/wiki/Central_limit_theorem, http://www.stattucino.com/berrie/clt.html

Given a Normal distribution of an independent variable, COD, the minimum sample size for ensuring a 90% confidence interval and a 10% precision is determined by the following formula:

$$n = \frac{z_{\alpha/2}{}^2 * \sigma^2}{p^2}$$

Where:

n	Sample size
$z_{\alpha/2}$	Chosen confidence level for the confidence interval, determined by ά. For a confidence interval of 90%, $z_{\alpha/2}$ is 1.645.
σ^2	Variance
p	Length of the confidence interval = Precision

From the data of COD taken by the project promoter during 2007 and 2008, and used for the determination of the mean COD ex-ante, the following table shows the mean and variance values. In order to consider a more robust value of the mean and the variance for the normal distribution, COD measurement corresponding to both years, 2007 and 2008, have been used.

Also, for the calculation of the mean and the variance, both maximum and minimum values of COD measured in this two-year period have been excluded from calculation.

Outlet COD						
Average COD Outlet (fined)	3.132	1.540	1.264	1.047	691	397
COD Removed		1.592	276	217	356	294
Variance	726553	98597	59955	43378	40172	12956
COD Values Max and Min are Removed from the Analysis. **Final data used in the calculation of Emission Reduction**						

Hence, according to the table above, COD follows a Normal distribution with known values of mean and variance, showed above.

For each value of COD, there is, obviously, a different value for the mean and the variance.

Considering each value, assuming that each COD is independent, that all COD measurements follow a Normal distribution, the minimum sample size is calculated according to the above mentioned formula.

For this purpose, each mean value is considered. The length of the confidence interval (L) is defined as a function of the 10% of the mean.

With these considerations, the minimum sample size is calculated. The maximum sampling period (days) to accomplish with the requirements (90/10) is calculated by dividing 365 days/year with the sample size in each case.

COD Values Max and Min are Removed from the Analysis. **Final data used in the calculation of Emission Reduction**						
Average COD Outlet (fined)	3.132	1.540	1.264	1.047	691	397
COD Removed		1.592	276	217	356	294
Variance	726553	98597	59955	43378	40172	12956
10% Mean	316	155	127	108	69	40
Sampling Size	20	11	10	10	23	22
Sampling period (days)	19	33	37	36	16	17

Hence, the shortest sampling period is determined for the COD outlet from aerated lagoons 1 and 2, which is 16 days. This means that sampling has to be carried out, at least, every 16 days, in order to ensure a 90/10 confidence/precision sampling result.

Once the project activity starts, the values of COD will be modified due to the modification of the treatment system and to the increase of the removal efficiency. This will imply that the variability of the measurements will probably decrease. Hence, the value of variance will also decrease and, so, the sample size required for achieving a 90/10 confidence/precision level.

Thus, considering the above, the project proponent, by developing a sampling process every 15 days, will achieve a 90/10 confidence/precision level, being in compliance with the EB requirements.

Sampling plan.

Sampling objective: *the plan should include the objective of the sampling effort, the time frame of the estimated parameter value(s) and the confidence/precision criteria to be met.*

The objective of this sampling plan is the determination of the annual mean of COD outlet from the different treatment systems during the crediting period with a 90/10 confidence/precision.

Field measurement and data to be collected: *the plan should clearly describe the variables and data to be collected, the scope and method of survey, their frequency and how the data will be used.*

The variables to be measured are the values of COD that are used in the calculation of the emission reductions in each verification period. These variables are the following:

Stage 1: *(this stage is out of the crediting period. However, the sampling plan will be implemented during the development of stage 1 and will be completely implemented when stage 2 will be operating).*

1. COD Outlet flotation tank / COD inlet to biodigesters
2. COD Outlet biodigesters / COD inlet aeration treatment
3. COD Outlet aeration treatment / COD inlet facultative lagoon nº1

Stage 2:

1. COD Inlet biodigesters
2. COD Inlet Physical-Chemical Flotation Tank
3. COD Outlet biodigesters
4. COD Outlet Physical-Chemical Flotation Tank / COD Inlet aeration treatment
5. COD Outlet aeration treatment / COD Inlet Secondary Decanter

The method of survey will consist of taking a sample of wastewater in the indicated points of measurement and the analyses will be according to the Standard Method for the Examination of Water and Wastewater (American Public Health Association).

The frequency of sampling is determined by the above explanation. The sample size has been determined according to the requirements from the EB 50 Annex 30, with a 90/10 confidence/precision level. The minimum sample size is 22 samples/year, which implies a sampling period of maximum 16 days. The project promoter will take a sample every 15 days.

These data will be used directly in the calculation of emission reductions, as per the methodological choices explained in the PDD.

Target population and sampling frame: The target population is the value of COD as explained before, considering these values outlet each treatment system involved in the project activity.

Sample method: water samples will be taken from the wastewater flow in each monitoring point, as described in the monitoring plan, every 15 days. Each water sample, taken as per the procedures described in the Standard Method for the Examination of Water and Wastewater (American Public Health Association), will be analysed to determine COD.

Desired precision/Expected variance and sample size: as it has been explained before, the precision to be achieved is 10% with a 90% confidence interval in the calculation of annual mean of COD. Variance has been estimated from a two-year sample and it has been considered as the variance for the calculation of the sample size, considering a Normal distribution for COD.

Since the project will imply a more robust and stable treatment, with a lower variability of organic load in the inlet of the treatment (due to the homogenization tank, the modification from an uncontrolled treatment as anaerobic open lagoons to aerated lagoons in which removal efficiency will be monitored), it is expected that variability will be lower, and so will be the variance. It is not possible to estimate a value of variance for COD once the project is implemented, but it will be lower than the variance calculated for the baseline treatment.

Procedures for administering data collection and minimizing non-sampling errors: data will be collected by qualified and trained technicians, as it was being done in the baseline scenario. The responsible technicians from Cooperativa Lar are properly trained in the wastewater treatment and know how to take the samples in the wastewater according to the Standard Method of Examination of Water and Wastewater, which describe exactly how samples have to be taken and analysed.

In order to minimize the analysing errors, one out of every three samples will be sent to an external laboratory which will analyse the COD according to the same standard. Measurements of COD made at Cooperativa Lar will be cross checked with the results from the laboratory, which will aware of any abnormality in the measurement at the project promoter facilities.

In case of differences between COD measurements from Cooperativa Lar and the external laboratory, the third party measurements will be considered for the calculation of mean COD and the relevant measures will be implemented at Cooperativa Lar in order to determine the reasons of the differences and repair any mistake in the measurement procedure.

Implementation: *the schedule for implementing the sampling effort should be defined as well as an indication of who will conduct the actual data collection and the analyses*.

Data collection will be done as in the baseline situation. Responsible and qualified technicians will take the wastewater samples and the analyses will be developed in the laboratory in Cooperativa Lar by qualified technicians.

As a quality assurance and control procedure, it has been mentioned that one of each three samples will be also analysed in an external laboratory. Measurements for these "cross-checking" samples will allow the technicians from Cooperativa Lar to diagnose any interference or any mistake in the analysis procedures developed at the industrial facilities.

Sampling plan evaluation

- *Does the sampling plan present a reasonable approach for obtaining unbiased, reliable estimates of the variables?*
    - According to the statistical approach, based on a Normal distribution of COD with mean and variance known, it has been demonstrated that the mean COD calculated from the samples taken every 15 days, accomplishes with the confidence/precision level of 90/10 required by the relevant guidelines. Moreover, with the project treatment, it is expected that mean will vary less than in the baseline scenario, hence resulting in a lower value of variance. This lower variance would reduce the sample size necessary to ensure the confidence/precision level required.

- *Is the data collection/measurement method likely to provide reliable data given the nature of the parameters of interest and project, or is subject to measurement errors?*
    - Data collection method will result on reliable data. Sampling points are determined in the monitoring plan in the relevant places in which COD has to be measured. Wastewater samples will be taken at these sampling points and these samples will be analysed as per the Standard Methods of Examination for Water and Wastewater. Hence, there is no source of errors neither from data collection nor from wastewater analyses, which will be carried out under an international standard. Apart from this, the quality control procedure established in the monitoring plan for COD measurements, which involves a third party laboratory, will ensure the reliability of data.

- *Is the population clearly defined and how well does the proposed approach to developing the sampling frame represent that population? Does the frame contain the information necessary to implement the sampling approach?*
    - The population is clearly identified: the COD outlet from each wastewater treatment system. The proposed sampling procedure ensures that the sampling size represents the population since the analysed variable is assumed to be Normally distributed.
    - The sampling frame, determined by the sampling points as defined in the monitoring plan and referred to a minimum sample size of each COD, will contain the information necessary to implement the sampling approach, which is the value of COD.

- *Is the sampling approach suitable, given the nature of the parameters, the data collection method and the information in the sampling frame?*
    - The data to be analysed is COD. As it has been explained, the sampling procedure is completely suitable (it has been developed in Cooperativa Lar in the baseline situation) and the sampling frame is defined in such a way that all the COD data required for the calculation of emission reductions will be collected and analysed.

- *Is the proposed sample size adequate to achieve the minimum confidence/precision requirements? Is the ex ante estimate of the population variance needed for the calculation of this sample size adequately justified?*

    - The determination of the sample size required to achieving the confidence/precision level, has been explained in detail. This minimum sample size has been determined considering the requirements of confidence and precision and assuming a Normally distributed variable.
    - The variance estimated ex-ante considers the COD values in different points of measure in the baseline scenario. The variable is the same in the baseline situation and in the project situation, what makes this estimation reliable to be considered as the variance for COD in the ex-ante estimation.
    - In the baseline situation, there is no homogenization tank or process. This is the main reason of the high variability of the COD values. In the project situation, the wastewater treatment is more controlled and will result on more homogeneous values of COD in each metering point. This enhancement of the treatment and this homogenization of the water stream before entering the treatment, will reduce the variability and, hence, the variance. Thus, the sample size required for the accomplishment of the confidence/precision requirements will be widely met with the proposed sampling procedure and size.

- *Are the procedures for data measurements well defined and do they adequately provide for minimizing non-sampling errors? Is the quality control and assurance strategy adequate? Are there mechanisms for avoiding bias in the answer, including possible fraud?*

    - The procedures for data measurements are based on an international standard specific for wastewater examination. Hence, they are specifically defined for avoiding sample errors.
    - The quality control and assurance strategy involve a third party for cross-checking the measurements made at Cooperativa Lar. In case of non-matching results for COD measurements, the data from the external laboratory will be considered valid. However, these non-matching results cannot be considered to be related with the sampling method, but with the development of the measurement standard.
    - Every six months, a statistical analysis of COD measurements will be developed and it will be checked that the results follow the estimated Normal distribution. Variance of the six-months sample will be calculated and it will be checked that these results are in accordance with the assumptions made for the determination of the sample size determination.

- *Are the persons conducting the sample activities qualified?*

    - Qualified and trained technicians from Cooperativa Lar have been developing the COD analysis in the baseline situation according to the Standard Method of Examination of Water and Wastewater. These technicians have received the proper training for this purpose and are properly qualified not only for the sample taking process, but for the COD analysis development. The same procedure of training, sampling and analysing will be carried out during the whole crediting period, attending specifically to the frequency of sample taking required for ensuring the 90/10 confidence/precision level.

Appendix 1

Abbreviations

CDM	Clean Development Mechanism
CER	Certified Emission Reductions
PP	Project Proponent
ECP /PAC	Environmental Control Plan / Plano de Controle Ambiental
SS	Suspended Solids
COD	Chemical Oxygen Demand
BOD_5	Biological Oxygen Demand (5 days)
O&M	Operation and Maintenance
GHG	Green House Gas
IPCC	Intra governmental Panel for Climate Change
KP	Kyoto Protocol
GHG	Green House Gas
PDD	Project Design Document
QA	Quality Assurance
QC	Quality Control
DOE	Designated Operational Entity
UNFCCC	United Nation Framework convention on Climate Change